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Pest Control (Tropical)

WORLD CROPS

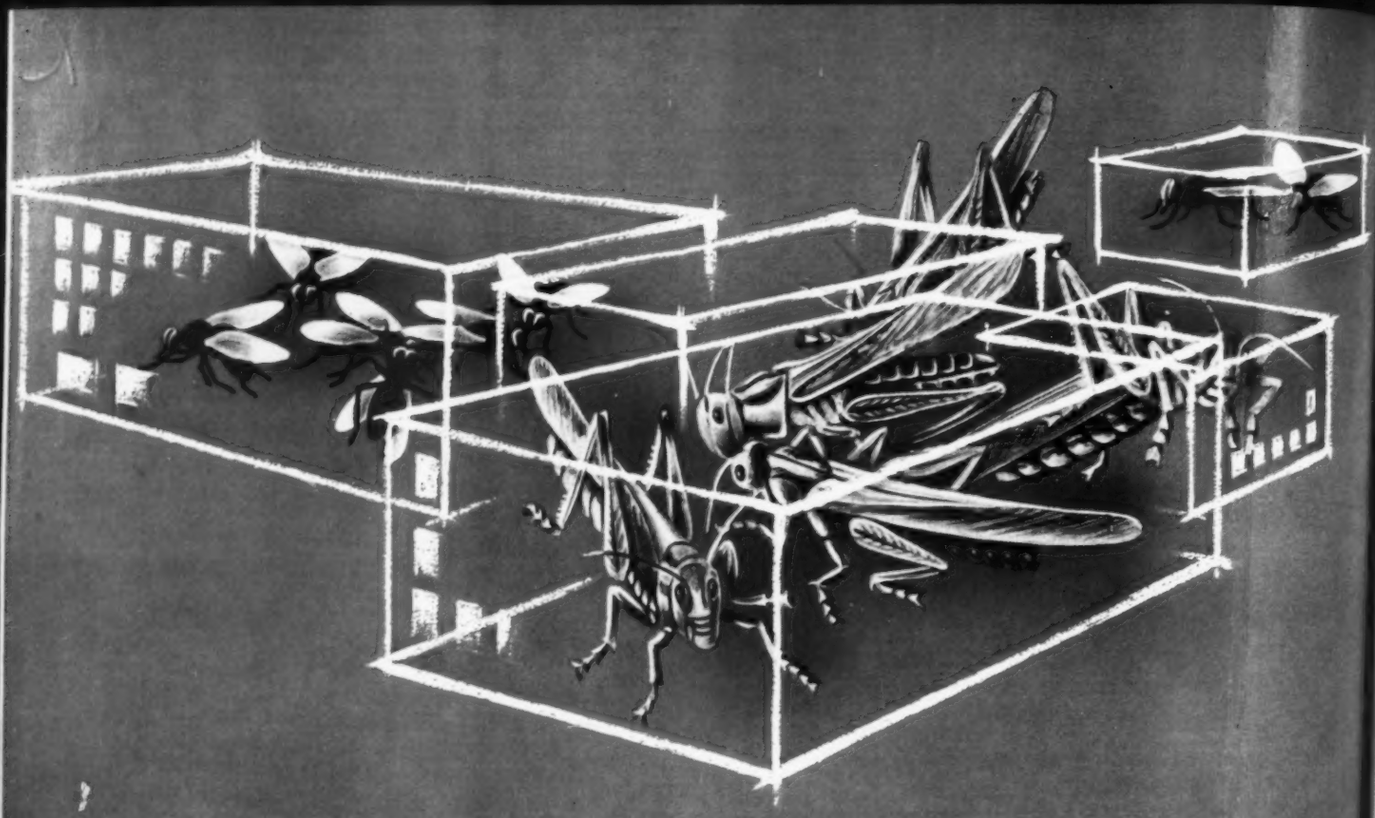
Agricultural Chemicals, Farm Supplies and Machinery

VOLUME 12, No. 6 JUNE 1960

A Publication of The Leonard Hill Technical Group

One of Frank Towner's cherry orchards at Maidstone in Kent, planted in 1904. A regular spray programme, employing Ialine colloidal copper and Ialine standard tar oil winter wash, eliminated bacterial canker in the first three years. The same programme is still used annually as a protective measure after twenty-five years' successful spraying

For further information see page 208



A hostel for locusts and flies?

Flies of all colours and shades, voracious locusts – in fact, insect pests from all over the world

take up residence at the Biological Institute of Farbenfabriken Bayer at Leverkusen, where they live a life of studied late, accomodated behind glass and in wire cages. Their stay at this Research Centre which is so highly important to crop protection, is by no means voluntary. All these pests have been brought here because they have one thing in common – they are highly dangerous to the health of mankind and to the preservation of our crops.

A few members of one or the other species assembled here are continually called upon to give their lives by allowing themselves to be exposed to the effects of a newly developed insecticide. This will show whether the long years of laboratory research on this product has been worthwhile. If so, it will now depend upon the results of the field tests that follow whether the new preparation can be declared full suitable for distribution throughout the world to give agricultural crops sorely needed treatment and protection, and a better chance to flourish.

Very few people are aware of the efforts, tests and frustrations that precede the development of a crop protection product before it meets all the many requirements and standards that have to be satisfied in the field. The very large number of products which have left our factory bearing the "approved mark", have quickly given excellent proof of their high efficacy and reliability, and are today used all over the world in all crops to combat the huge army of insect pests and causal organisms of deadly diseases.

Farmers in all countries of the world have the assurance that every product which bears the "Bayer" Cross, has been subjected to hundreds of tests.

Cupravit, fungicidal copper spray
Pomarsol, TMTD spray
Folidol, E 605, methyl parathion, ethyl parathion
Metasystox, Systox, systemic insecticides
Dipterex, Gusathion, new type insecticides
Hedonal, herbicide
Tugon, fly killer
Seed dressings of all types for all uses
(mercury, hexachlorobenzene, TMTD, COBH)

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Editorial Comment

Confusion Worse Confounded

THERE IS an extraordinary degree of confusion in the nomenclature of chemicals used in the crop protection business. Trade names, trade marks, common names, proposed common names and chemical names are often not clearly defined or known. This state is particularly unfortunate in the field of insecticides, where many products, quite closely related chemically, have widely different properties both as regards biological performance and safety, yet have in many cases no common names and are only known under trade names.

This has led to a good deal of confusion in the minds of many quite knowledgeable people, particularly in the field of the organo-phosphorus insecticides, where confusion is at its worst. There are a number of quite recently introduced products which, though they are not perhaps yet widely used, are likely to be so.

There is already a good deal of involuntary infringement of trade names, through ignorance of the existence of common names or proposed common names. The British Standards procedure for adopting common names is a very slow one and so is the American, and the two do not necessarily agree. In addition, we have cases where countries which are not members of the International Convention agree to permit the registration as trade marks of names which are generally accepted as common names.

Combined International Operation

A MEETING WAS recently arranged in Rome by FAO to consider a plan for a combined international operation over a period of six years against the desert locust.

Dr. Norman Wright, the Deputy Director of the Organisation, in tracing the history of the project, announced that 19 governments in the areas liable to locust infestation, had pledged $1.25 million and that the Special Fund of U.N. had authorised an expenditure of $2.5 million to support the operations and had charged FAO with the responsibility for executing this urgent and important international project.

Obviously it is essential that such a campaign must be based on one integrated plan which, to be fully effective, must be planned primarily on technical considerations. The operations must be concentrated where they can be most effective and can provide the greatest and most lasting benefit to all the countries affected by this historic past.

This big contribution from the Special Fund will provide the necessary stimulus for governments to work together and build up a more effective and less costly technique for its control, and it will obviously relieve individual governments of their present expenditures on locust control within their own borders, which is only effective if adjoining countries do the same and as efficiently. Their work could be completely nullified by inadequate controls in adjoining territories. This all emphasises the importance of a single planned operation.

On Rolling Tea

DURING MR. LEONARD HILL'S recent tour of Kenya he visited a tea factory for the first time. As usually happens in such cases, he was greatly impressed by the tea-rolling machines, in which withered leaf is distorted and crushed to bring about the so-called 'fermentation' process of black tea manufacture. This damage of tea leaf by rolling or other means is a subject which is now under very active study.

In the early days of the tea industry in Assam, from 1835 onwards, the China hand processes were followed. By 1870 rolling and firing machines had been invented, and by 1890 the tea houses were mechanised and had become tea factories. The tea roller comprises an open box, to contain the leaf, which revolves on a table. The resultant stirring of the leaf resembles, in effect, the hand process, but one roller can deal with about 400 lb. leaf per hour, against the 30 lb. per day that can be rolled by hand. Orthodox tea manufacture comprises four stages: withering, rolling and fermentation, and firing. Rollers are emptied and recharged at intervals, so that tea manufacture is a batch process.

Turgid, poorly withered leaf does not roll well, but flakes and spews out between the box and the table on to the floor. About 1925, planters in the Dooars overcame this defect by cutting under-withered leaf into thin strips with a tobacco cutter before putting it in the roller. Soon the withering process was omitted altogether and fresh leaf was cut, rolled, fermented and fired. Such a procedure makes only 'brokens', and no leaf grades. The liquors are bright, brisk and sometimes 'brassy', but are useful for blending.

In 1930 the McKercher C.T.C. (crushing, tearing and curling) machine was invented. This consists of two metal rollers with scored surfaces, working like a mangle, one roller making 70 and the other 700 r.p.m. The leaf is withered in the normal way, given a half-hour roll, then put through the C.T.C., where it is instantaneously distorted. This extra damage enhances the changes of fermentation and gives a stronger, more coloury tea. As with the tobacco cutter, only 'broken' grades result.

Other changes in tea leaf preparation are under trial and great importance is attached to the recent invention of the 'Rotovane' at the Tea Research Institute at Tocklai. This consists of a tubular,

rotary action machine, into one end of which the withered, lightly rolled leaf is fed and then propelled to the outlet end by screw-like fins, suffering distortion on the way. The process is continuous, the passage from feed to discharge taking 4 to 5 min. The 'Rotovane' may augment the work of the orthodox roller, or it can be used in conjunction with the tobacco cutter or the C.T.C. machine.

A Complex Reaction

THE CHEMISTRY of tea fermentation, as far as liquoring qualities are concerned, has been correlated with these modern trends in manufacture. Tea fermentation is a multi-complex time reaction, involving a whole range of oxidation and condensation products. These substances are produced from certain leaf polyphenols and are related to the briskness, strength, colour and body of the infusion. Two polyphenolic bodies are mainly concerned and these make up about 22% of the solid matter in fresh leaf. With orthodox manufacture, employing the gentle action of the roller, about one-third of these polyphenols remains unchanged. With the more vigorous C.T.C. action, however, practically all these bodies are oxidised.

The packet teas of commerce are blends, and all types of liquors are needed in their make-up. Recently there have been indications that there may be an over-supply of C.T.C.-produced teas on the market. The problem is to maintain a nice balance in the supply of orthodox, tobacco-cut and C.T.C. teas.

Example and Precept

AN UNUSUAL example of racial integration, already in practice, has just reached us from Kenya, where that progressive farmer, Lord Portsmouth (see WORLD CROPS, 1960, **12**, 170), is taking into partnership an African from one of the neighbouring reserves. He will teach him not merely how to grow pyrethrum, but also how to grow it profitably, so that the partnership can be established on a proper business footing.

Obviously it is not only 'know-how' which is required for the successful cultivation of cash crops, but also the necessary business discipline to ensure a successful project. This is often overlooked, yet it is so obvious.

The Soya Bean

THE SOYA BEAN, *Glycine hispida*, is a hardy, erect annual, normally from 2-6 ft. high, depending on the variety and soil, which is indigenous to China and Japan, where it has long been cultivated as a food crop and stock feed. It was introduced into other parts of the world—East Bengal, Indo-China etc.—and today the U.S.A. is a very large producer of this important economic crop.

The short hairy pods contain three or four seeds, which are a nutritious food, being next in importance to rice in China and Japan. The smooth pea-like seeds are cooked and prepared for food by boiling, by roasting, by grinding into flour and by conversion into the well-known soya bean sauce. They contain little or no starch and are second only to meat as a source of protein. They are made into biscuits or bread for diabetic patients and in India are eaten like *dhal*. Soya bean oil is a valuable soap and margarine ingredient, and the residual cake forms a nutritious cattle food.

Soya beans are today one of the leading oil-seed crops in the U.S.A., and Mr. Howard L. Reach, president of the Soya Bean Council of America, is now carrying out a world-wide educational tour for the Foreign Agricultural Marketing Department of the U.S. Department of Agriculture. His object is to meet government officials and health officers in each country he will visit and help them to find the most effective way of using soya beans and soya bean products in human nutrition, animal feeds and industry.

Salmonellae Amok

THE OUTSTANDING food-poisoning problem in Britain is the control of salmonellae. A report on food poisoning in England and Wales in 1957, published in the November issue of the monthly bulletin of the Ministry of Health and the Public Health Laboratory Service, discloses that these organisms caused 20% of reported general outbreaks, 64% of family outbreaks and 62% of sporadic outbreaks. In 95% of all cases in which the casual agent was identified, salmonellae were the culprits. During 1957, 7,071 cases of food poisoning were reported, a decrease of 8% on 1956 and 21% on 1955. Fatalities numbered 36, 32 being due to salmonellae and three to *Cl. Welchii*, the cause of one being unknown.

Of 200 general and family outbreaks for which information was available, the vehicle of infection in 145 cases was meat, with processed (other than canned) and made-up meat as the villains of the piece of 137 of these. Of special interest was 17 outbreaks due to canned peas, most of the peas concerned being from one producer.

Recently a new source of infection has been reported, *viz.* desiccated coconut, a product which comes to Britain mainly from Ceylon, the original home of the d.c. industry. The infection has been proved and widely mentioned in the British Press. The consignment in question has been condemned, but the trouble will undoubtedly recur unless the industry is brought up to date and malpractices, such as the use of contaminated wash liquors, packing into contaminated bags and the blending of the product of several factories, is stopped. If an embargo were to be placed on desiccated coconut, the whole industry could be wiped out. A good name and a reputation for good quality is therefore something to be jealously guarded.

In case anyone should doubt this, we would cite the case of the Singapore pineapple industry, which, owing to serious complaints regarding quality from its principal buyer, Britain, was forced either to rationalise and reorganise its canning industry, or go under. In 1936 the Board of Pineapple Packers and Shippers was constituted, the whole industry was reorganised, 12 inefficient factories were closed and the number of licensed factories was drastically reduced from 20 to eight, so that through the economies thus made the industry could be established not only on a more efficient but also a more profitable foundation.

Four-Legged Pests

TWO EMINENT Indian scientists, Dr. Nirula and Dr. Menon, of the Indian Central Coconut Research Organisation, have contributed an article for this issue on the subject of the insect pests of the coconut palm, which provides new ideas on a subject which hitherto has suffered from too much repetition without new ideas being forthcoming. Perhaps the most serious pests, as measured by the extent of the damage they can do to coconut properties in remote localities, neither fly, nor creep, nor burrow—they are the four-legged, leaf-eating pests.

One of these is the subject of the cartoon in this issue; then there is the starving village cow which invades unprotected properties seeking what it can devour; there are also wild animals — pig, deer, bears, porcupines, hares and rats, which are all leaf-eaters and can do colossal damage if not controlled, particularly where the estate is on the edge of the jungle.

A Lovable Pest

JUMBO IS a lovable beast and we have stood for hours waist deep in water behind a protecting screen of jungle foliage, watching his antics.

In the past the usual method of control was by shooting this noble beast and two big game hunters claimed to have disposed of 1,200 and 1,000 respectively. Today, with numbers severely reduced, smallholders living on the edge of the jungle try to scare the elephants away with their decrepit guns and a wounded elephant can become a rogue.

Meanwhile, as the population increases, so the jungle recedes and in a few years' time the elephant will be exterminated, since, for biological reasons, they cannot multiply in limited areas of jungle.

Control by Burglar Alarm

WE WERE once faced with the problem of establishing an isolated seed garden for coconuts in an area of jungle, where the rainfall was erratic and inadequate. Water was needed for the plants, and the garden had to be placed close to a water hole. This clashed with the immemorial rights of the resident population of elephants, which move seasonally from jungle to jungle, and elephant walks lead to all the principal water holes. As elephants love young coconut leaves, it would have been impossible to have established the isolated garden unless complete control could be obtained. We consulted two of the leading authorities on elephants—'Elephant Bill' Williams, of Burma, and Major C. Weinman, the curator of the magnificent Colombo Zoo.

We proposed the costly idea of a deep trench or, conversely, an impenetrable barrier of broken jungle timber. The answer was that the elephants would enjoy sliding down into the trench just for fun and they are intelligent enough to push over a sizable jungle tree so as to be able to walk across our barrier. The same argument applies to electric fencing and submarine netting. Finally, it was decided to put a burglar alarm across the elephant walk, consisting of a sprung wire operating two klaxon horns. Other methods used were the employment of watchers with recording clocks to prove their devotion to duty, the burning of old rubber tyres and the sounding of gongs and firecrackers. Together these measures proved effective.

Catch Them Young

THE YOUNG FARMERS' movement is forging ahead in Britain and providing a means whereby farmers who, in some instances, are still conservative in their methods, can be introduced to new ideas through their children.

'So what are we supposed to do?'

A national competition for which 28 Young Farmers' Clubs will qualify is being sponsored by Fisons Fertilisers Ltd. The competing clubs are running their own fertiliser demonstration fields and these are now reaching a stage when the difference between various fertiliser treatments clearly shows the need both for balanced and for adequate fertiliser usage.

The search is now on for the club with the best demonstration station and whose members are the most knowledgeable on fertiliser matters. Five clubs—one from each of the five major agricultural areas of Britain—will enter the finals, a contest to decide what the individual members of these five clubs have learned about fertilisers from these operations.

Questions and answers are to be tape-recorded and the winning club recording will be made available to the other clubs for discussion at evening meetings in the winter—and the prize? This will take the form of a farming tour in East Anglia—the 'Granary of Britain'—and a visit to London, with all expenses paid. In the course of this tour the winning club will visit outstanding farms, research stations and the demonstration centres of clubs in that area.

Precept, Demonstration . . .

WE UNDERSTAND that the first of these Young Farmer demonstration stations was established in 1956 in South Wales and this was followed by a big increase in the numbers participating in 1957 in other parts of Britain. As they provide a useful example which other countries could usefully emulate, our readers will be interested to learn some details of the scheme.

Each Y.F.C. hires an acre of land, which the members fence off and cultivate in six sections, which are cropped in rotation. Each field is divided into ten plots which receive the major plant foods, applied singly and in various combinations over a period of six years or even longer, and finally, where possible, the cash returns and the net profit are determined. These provide very valuable evidence on the need for correctly balanced and adequate fertiliser usage.

. . . and Purpose

THE object is to show the best treatment for the crops normally grown on soils in that particular locality and to demonstrate the value of modern chemical techniques where weeds or pests may affect yields.

The project has the great advantage that it provides continuous interest for the members throughout the year with practical work in summer and discussion of the results each winter—and for a number of years. Most important of all, the information so obtained reaches the farmers through the club members—the farmers of tomorrow.

Our Policy

ADDRESSING THE quarterly meeting of the National Production Advisory Council on Industry, which was attended by leading industrialists and trade unionists, Mr. Heathcoat Amory, Chancellor of the Exchequer, said: ' . . . A big rise in exports is certainly desirable and should be attainable'.

Agricultural engineers are already playing their part, for out of a total estimated output of agricultural machinery and implements valued at £163 million no less than £105 million was exported last year, including a record number of tractors. The total production of these in Britain in 1959 amounted to some 165,000, of which 115,796 were exported, and, according to a recent report received from the Agricultural Engineers' Association, 'Britain is now sending overseas more than the whole of the rest of the world put together'. Otherwise expressed, the overseas market is now far more important than the home market.

It is no coincidence that the leading exporters of agricultural machinery, agricultural chemicals and horticultural equipment are all consistent advertisers in the International Journal of Agriculture—WORLD CROPS. Our policy is to serve the world's greatest industry, which is agriculture, at the highest level through Ministers of State and Directors of Agriculture, through leading agricultural scientists and field advisers, through land development and colonisation authorities, through overseas agents and importers and, of course, through foresters, planters, farmers and commercial growers of world crops, with the broad general purpose of increasing the productivity of the earth to meet the ever-rising needs of an ever-increasing human population.

This Month's Front Cover

Copper is probably the most effective fungicide available, since a few parts of copper per million are sufficient to kill most species of fungus spore. Some forms of copper are liable to cause damage to plants, but Ialine Colloidal Copper is specially formulated to minimise this risk. It has been used successfully by growers throughout the world.

Ialine Colloidal Copper is a bluish-green paste which can be poured easily and consists of a copper compound in an extremely fine state of division. It is very much finer than wettable powder fungicides, is more uniform, and adheres more tenaciously to the foliage.

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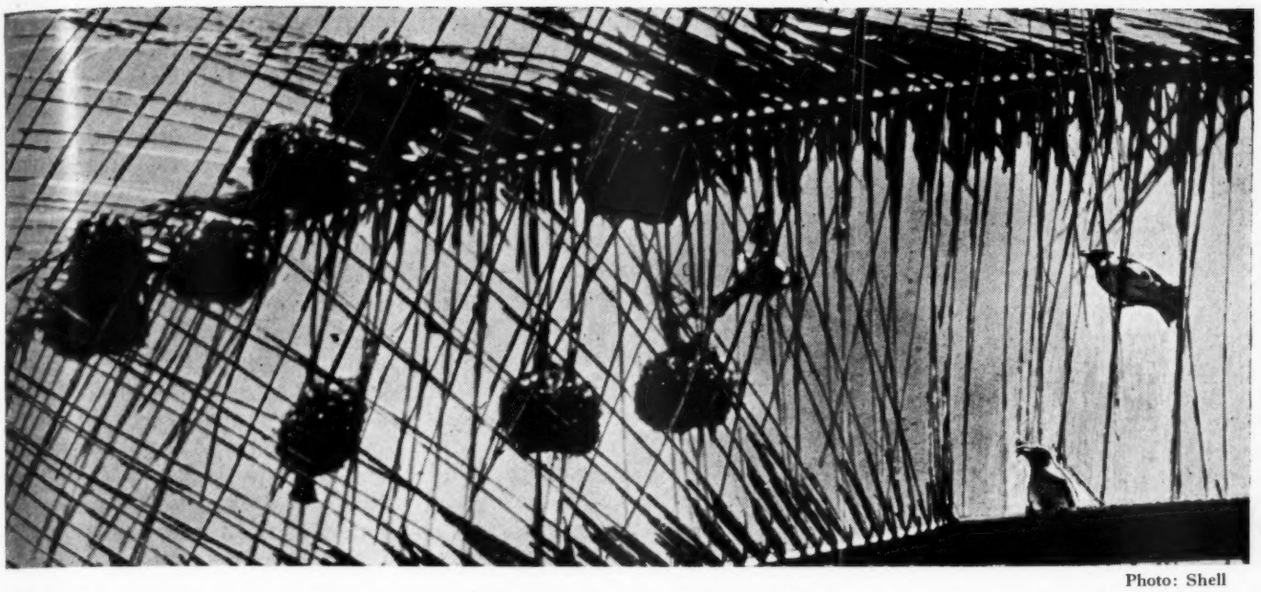


Photo: Shell

Weaver birds and their nests. The male bird builds the outer part of the nest with strips of leaves or grass, making an entrance hole at the bottom. The birds in this photograph have used the leaves of a palm tree as a building material; the outer fronds have been torn away, leaving the midribs on which the nests hang. The female bird lines the nest with soft materials and lays 1–3 eggs

The Quelea Bird

A Problem of International Control

N. HESELTINE*

The Quelea bird of Africa is as serious a pest as the Desert Locust, but international co-operation for its control is lacking.

UNDER different names, Sudan dioch, mange-mil or weaver-birds, the *Quelea-quelea* and its various sub-species, cause serious damage to grain crops over all the drier areas of Africa, from Senegal to Somalia, and from Somalia to the Transvaal. Although many other species of small weaver-birds attack cereal crops in the savannah regions, none of them forms the vast swarms of *Q. quelea*, numbering literally millions of birds.

The damage done, and the difficulty of protecting fields against these huge flocks, is strictly comparable to the ravages of the Desert Locust, *Schistocera gregaria*, in its periodical invasions of the East and West African savannah regions.

Regions affected

Damage to sorghum and millet, rice and wheat, is perennial and in the past has caused famines of varying severity. Like the Desert Locust, the Quelea bird attacks areas of low rainfall which are already marginal for certain crops, and where the cropping season is strictly limited by low-rainfall. The economy of the African savannah regions, being far less diversified than the high-rainfall areas, is particularly vulnerable to pests and diseases and to drought, especially where these attack the basic food crops as in the case of Quelea.

Seasonal damage is in fact so widespread that it would be difficult to estimate quantitatively, but reports from Senegal in 1953 indicated that the large-scale rice schemes in the Senegal valley were so affected that abandonment was considered, while in Northern Nigeria (Sokoto and Borun) Quelea infestation seriously limits the productivity of new rice schemes. Sorghum losses in the Northern Transvaal (European area) were estimated at £500,000 in 1953 and many farmers have given up growing sorghum, for which the low-rainfall area is particularly suited. Great damage has been done to wheat crops in Kenya and on Kilimanjaro in Tanganyika.

Swarms in millions

Quelea are known to have been a recurrent plague long before the arrival of Europeans in Africa; under natural conditions its food is the seed of so-called ' sweet ' grasses, especially varieties of *Panicum*, *Setaria*, *Urochloa Digitaria* and *Eragrostis*. Estimates of the numbers involved are difficult to assess, but figures of 200 million adults were given for the Senegal valley in 1953†, and it is stated that

*Liaison Officer for Africa, Food and Agriculture Organisation of the United Nations.

†Figures from report of the Organisme de Lutte Antiaviaire-Senegal-Mauritanie.

Sénégal. Nests of Quelea quelea

flocks in East Africa are even larger. Simple calculations of average daily consumption of only a few ounces per bird, would indicate annual losses of grain of hundreds of thousands of tons.

Nesting sites have been reported covering up to 200 acres in the Transvaal and 800 acres in Tanganyika, while a swarm destroyed at Warmbaths in the Transvaal in 1953, in a roost, covering only 1.9 acres, numbered over 3 million birds. Breeding takes place sometimes in tall trees which may contain up to 1,000 nests each, in dense thorn scrub, or in reeds. Large breeding colonies are found on Lake Chad from which huge swarms disperse over wide areas of Northern Nigeria, French Equatorial Africa and the Cameroons.

The Quelea appears to have no natural enemies capable of effective control, and experiments show it to be remarkably resistant to disease. Predators such as the Marabou stork, nearly all birds of prey, snakes, and local inhabitants who use the young birds as food, make no impression on total numbers. There are no reports of Quelea being found dead in any quantity even in times of severe drought, but it is thought that there are periodic increases or decreases in the size of flocks, which have been stated to follow a 4-year cycle in East Africa.

Steady annual increase

It would seem logical that the absence of natural limiting factors, coupled with a general extension of grain crop cultivation, have resulted in a steady annual increase, and that the only check on the total Quelea population is the availability of its food and water supply. The general pattern of the seasonal migrations and breeding areas of the Desert Locust in relation to winds, rainfall and seasonal vegetation is understood broadly, though much further study is required. Some similar relation probably exists between the annual rainfall and the behaviour of the Quelea, since the young require seeds of grasses and grain crops in the 'milky' stage and will not survive if fed dry seeds. The large nesting sites of Quelea will usually be near water, either in reeds such as the colonies on Lake Chad and Lake Rukwa, or in bush near permanent water.

Swarming and migration

Little is yet known of the migration of Quelea, although it is certain that extensive movements take place according to seasonal variations of vegetation. Ringed birds have been found 600 miles away from their places of origin, but no seasonal pattern of migrations such as that associated with the Desert Locust is recognised. The ecology of the Desert Locust suggests that it lives in an unstable environment and that nomadism is necessary for its survival; the increase in available food supplies for the Quelea would have reduced the need to migrate and may have tended to fix large bird populations in grain-growing areas.

The expansion of grain crop cultivation in the central plateau of the Union of South Africa, and perhaps the replacement of the Red Oat grass, spiky *Themada triandra*, which is not much attacked by Quelea, by preferred species of pasture grasses, may have removed local need for migration by providing an all-the-year round food supply. The establishment of rice cultivation in West Africa, notably in the dry savannah country of Senegal and the French Sudan, has provided an abundant alternative food supply to the sparse grasses of the surrounding countryside.

The nesting season is dependent on the rains, breeding in Tanganyika taking place in March and April during and after the long rains. After nesting, the birds migrate and flocks of adult and young birds migrate east and north-east. Movement back and forth takes place over much of east Africa, resulting in the formation of huge flocks. Millions of birds are found, for example, in Masailand in Tanganyika in September and October, and also to the south of Kilimanjaro.

Two sub-species overlap in East Africa (*Quelea q. lathami* in the south and *Quelea q. aethiopica* in the north-east) and although there is no reason why these large flocks should not migrate seasonally from the Sudan to South Africa, following the rains, it is not thought that any regular north-south movements take place with the seasons. What is certain is that large flocks move over considerable distances in the arid savannah regions.

For effective control of a highly mobile and swarming pest such as the Quelea or the Desert Locust, accurate knowledge is needed of its population dynamics, and of its migration and concentration areas which may be the source of new plagues. The main migrations of the Desert Locust, depending largely on weather, are fairly well mapped, but the delimitation and ecological characteristics of the principal breeding areas depend on detailed ecological surveys, such as those now being carried out by FAO in collaboration with UNESCO, over the whole breeding area from Senegal to Western India.

Unco-ordinated data

Although much data on the biology and habitat of the Quelea bird have been accumulated by workers in the whole of the affected area, it is

Sénégal. Swarm of Quelea settling in the rice fields

necessarily based on local observations over a limited range, with few comparative studies. As international co-ordination of observations and control measures in different areas is lacking, knowledge of migrations is largely conjecture, and so no comprehensive map exists of the main nesting areas, by no means all of which are known.

Crop protection measures

Control measures have been organised locally with such means as are available on the spot, and in spite of occasional large kills such as that mentioned above, cannot be said to have had much more effect on total numbers than the natural predators.

The African farmer traditionally protects his grain crops by trying to scare away the birds. In the Senegal valley, local chiefs would call up all the villagers to scare away an invasion, to prevent flocks from roosting and to destroy nests. Elsewhere, individual farmers have always tried to organise their own protection, but this means an incalculable loss of time and effort and is by no means effective. Little was done by local administrations until about 1953, but since then much has been achieved. Specialised bird control officers have been appointed in the Union of South Africa, Rhodesia, Tanganyika,‡ Kenya and Nigeria, while in French West Africa the well-equipped *Organisme de Lutte Anti-aviaire* has been in operation for the past six years.

Methods of control

Methods of control are very varied, and consist either of direct defence against invasion, or the destruction of the birds in their roosting and nesting sites. These measures are in fact an extension of African protection methods by modern means. To drive off the birds, sirens, detonators, smoke-producers and low-flying aircraft have been tried, without any lasting effect, since the birds appear to accustom themselves rapidly to recurring disturbance. Local inhabitants have been mobilised to keep birds on the move when they come in to roost, and if sufficiently disturbed they go and roost elsewhere, perhaps to return in greater numbers the following year.

‡The Government of Tanganyika spends more than £11,000 per annum on combating the Quelea bird.

Mauritania. Attacking Quelea bird nests with a flame thrower

Methods of extermination have so far proved reasonably effective in the Senegal valley, where very large numbers of birds and nests have been destroyed (30 million birds and 46 million nests in 1955). This is, however, a small area compared with Tanganyika and Kenya, where destruction has been carried out with good results, but only very locally.

The approach is simple. Roosting or nesting sites are located, and are then attacked by laying explosive charges. The most effective appears to be the method described in Tanganyika of laying small charges of explosive against oil-drums filled with a 50 : 50 mixture of diesel oil and petrol. The resulting explosion is said to produce a Bikini-type 'mushroom', rising several hundred feet. Kills of 400–600 birds per sq. yd. area have been reported from South Africa, and one operation in Tanganyika destroyed over 3 million birds.

In French West Africa and the Cameroons, flame-throwers have been used. These are not always effective in thick bush, and the forest timber needs to be of no value, since huge bush fires result from this method, but flame-throwers have been useful for destroying nesting sites on a large scale. Neither explosives nor flame-throwers are of much use against the huge bird populations nesting and roosting in reeds, such as *Phragmites*.

Poison bait has been advocated in South Africa, using strychnine or parathion, but apart from a general usefulness in discouraging the formation of large flocks, it is dangerous, especially among African farmers.

Spraying from the air with parathion has been tried, and the results of one such operation in the French Sudan in 1958 were described to the writer. Roosts in reeds in the inland delta of the Niger, near Macina, were sprayed at dawn, but not early enough for the birds to die at their perches, with the result that they dispersed over a very wide area. Their dead bodies were eaten by vultures and various animals who then died in their turn so that rotting carcasses littered several hundred square miles. Obviously parathion cannot be aerially sprayed over a densely-populated area.

Finally, biological control has been investigated, but once again the resilient Quelea demonstrates its resistance to Newcastle disease, fowl pox and various *Salmonella* infections. Experiments are in progress to breed a 'bird-proof' variety of sorghum, but this property depends on a high tannin content which makes the grain unpalatable for human consumption.

Two parallel problems

Comparisons have been made between Quelea damage and locust invasions in Africa because of the high

swarming populations, the extensive damage to crops, and the wide area affected, covering perhaps more than 20% of the whole continent. Locusts however occur in long-lasting, but nevertheless periodic plagues, whereas the Quelea bird would appear to be a constant hazard, with a tendency towards overall increase in numbers. Of the five important species of locusts in Africa only one, the Desert Locust, has not yet been brought under control largely because its seasonal breeding grounds and potential outbreak areas are so widely scattered.

It is significant that the African Migratory Locust (*Locusta*) and the Red Locust (*Nomadacris*) have been brought under complete control by international action. Outbreak areas, now reasonably well-defined, are effectively dealt with by international bodies, based on Kara in the Soudan Republic (formerly French Sudan) for *Locusta*, and on Abercorn in Northern Rhodesia for the Red Locust. Measures against the Desert Locust, through international co-operation, have been developed by FAO since 1951 from co-ordinating centres established by the Organisation at Jeddah in Saudi Arabia, and at Addis Ababa. International co-operation has been accepted as an essential weapon in fighting the Desert Locust and has shown itself to be effective, as well as economical, although many outstanding problems remain to be solved.

Sudan. Dead birds after explosion under a roost

International action essential

The need for international action against the Quelea bird was recognised by several interested governments, and meetings of specialists were organised by the CCTA, the first in Dakar in 1955, and the second in 1957 at which technical information was exchanged. International control was taken a step further when the Conference of Member-Governments of FAO passed a resolution in November 1957 requesting FAO to set up an international project for the control of the Quelea in Africa. Nevertheless there has been little response from governments in finding the funds required for this project.

Military operation

The undertaking is on a comparable scale with the control of the Desert Locust, and the work of biologists, associated with meteorologists and other scientists, must precede what is, in effect, a military operation, requiring the mobilisation of large resources in remote places. The area to be covered is enormous, and co-operation of all the governments concerned is needed to collect first basic data on breeding sites and migrations, and later to plan and carry out control measures on an international scale. Until such a control organisation is set up, territorial efforts will continue to be limited to defence, and no progress in limiting the total numbers of Quelea will be possible.

Photos on pp. 210, 211, 212: M. Mallemaire, bird control specialist attached to the Haut Commissariat Général at Dakar.

Research on Hops

A one-day conference for hop growers was recently held at Wye in Kent to discuss the results of recent hop research at Wye College. About 250 visitors were present, the majority being growers, with merchants, brewers and other branches of the hop industry also represented.

The first paper, read by Dr. Darling, head of the Department, gave a general review of hop research at the College. Mention was made of recently developed techniques for growing and propagating hops during the winter months under glass, thus making it possible for some essential lines of work to continue actively throughout the year. Hop manuring was discussed by Mr. Thompson, while Dr. Williams and Mr. Weston dealt with the carbohydrate food reserves of the plant. Dr. Coley-Smith gave the results of current work on the over-wintering of the downy mildew fungus, while Mr. Farrar read a paper on the seed content of the triploid hop varieties produced by modern plant-breeding methods at Wye. Mr. Bailey, a member of the National Institute of Agricultural Engineering, discussed modern trends in hop-drying research, in which work the Institute collaborates with the College.

£14 Million for Development

The Western Nigerian Government is to spend £14 million on a five-year development scheme for the region, commencing this year, according to a Barclays Bank D.C.O. message from Lagos. The initial phase, which is being rapidly pushed forward, envisages the establishment of 13 pilot agricultural settlements and five farm institutes. Plans include provision for development of cocoa, rubber and oil palm production, and in the savannah areas of Oyo and Ibadan Provinces emphasis will be placed on the production of food crops and livestock.

Insect Pests of Coconut Palm in India—1

K. K. NIRULA and K. P. V. MENON

This first part describes the three major pests of the coconut palm and some new methods of dealing with them.

WITH about 1.58 million acres under coconut, India has the second largest coconut-producing area in the world, yielding over 4,000 million nuts annually. Yet production falls short of the requirement by about 30%. One of the main causes for this deficiency is the serious damage inflicted by insect pests.

Photo: Shell

Adult rhinoceros beetle

Rhinoceros beetle

The rhinoceros beetle, *Oryctes rhinoceros*, is an ubiquitous pest of the coconut palm in India. The adult beetle bores into the crown of the palm, cutting and chewing the tender foliage and damaging the young inflorescence while still enclosed in the spathe. Sometimes it may cause the death of the palm by destroying the growing point. It is estimated that the beetle causes a loss of 5-10% of the annual coconut production in India.

Photo: Shell

Close-up of the larva of rhinoceros beetle, Strategus alocus

The beetle breeds in all types of decaying organic matter, such as cattle manure, refuse heaps, decaying vegetable matter and the dying and dead trunks of coconut and other palms. The duration of the life cycle, from the egg to the emergence of the adult, is about six months on the west coast of India.

A number of animals have been found to feed on it at various stages: rats, pigs, squirrels, chickens, ducks, owls, crows, lizards, toads, Carabid beetles, Histerid beetles, Elaterid beetles and centipedes. *Scolia oryctophaga*, which has given satisfactory control of *Oryctes tarandus* in Mauritius, was recently imported into India from Madagascar for trials against the rhinoceros beetle.

The larvae, pupae and adults of the rhinoceros beetle are attacked by the green muscardine fungus, *Metarrhizium anisopliae*. This fungus is most active during the south-west monsoon on the west coast, when it takes a fair toll of the pest.

Chemical control trials have shown that the pest can be successfully

controlled by the treatment of breeding places with 0.01% BHC (13% gamma isomer). Application of 5% BHC and sawdust in the leaf axils was also found useful for the control of adults during dry weather. Baits placed in coconut gardens, consisting of attractive materials and 0.1% BHC, are effective in attracting and killing adult beetles.

Coconut caterpillar

The coconut caterpillar, *Nephantis serinopa*, is another serious pest of coconut palms. Its larvae live on the under-surface of leaves in galleries made of silk and excreted matter and feed on the green tissues. The injury inflicted by numerous larvae causes the foliage to wither and when many fronds on a tree are similarly affected the reduction in yield is considerable. Its activity becomes significantly apparent during the dry months. The adults live for about five days, during which period each female lays 137 eggs on average.

The insect is subject to the attack of some natural enemies. Of these predators, *Microbracon brevicornis*, *Perisierola nephantidis*, *Elasmus nephantidis* and *Trichospilus purivora* have been bred in large numbers and released in *Nephantis*-infested areas for the control of the pest.

Successful chemical control of the pest has been obtained by spraying the palms with 0.2% DDT. In dry areas 0.2% BHC spray also gave satisfactory results, but in areas of heavy rainfall it was found to lose its residual toxicity very soon.

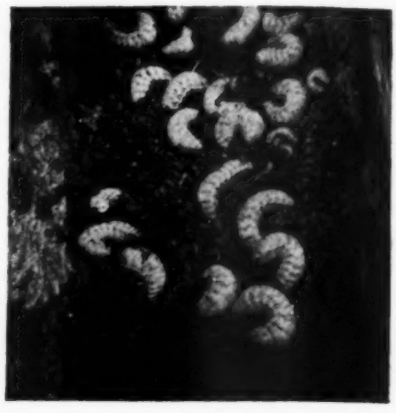
Palm weevil

The palm weevil, *Rhynchophorus ferrugineus*, is the most destructive pest of young coconut palms throughout India. Unlike the rhinoceros beetle, the adult weevil is incapable of causing any direct damage to the tree, but the early stages of the insect are passed on the palm and the damage caused by the larvae is often fatal to the tree. It is very difficult to detect the presence of the infestation in the early stages of attack, but sometimes a few small holes may be seen in the infested area, from which pieces of chewed fibre protrude and a thick brownish liquid oozes out. It has been estimated that 5% of young coconut palms below the age of 10 years are killed by this pest every year on the Malabar coast.

Copeland believed that the weevil would not lay its eggs in sound trees, but only in those where the soft tissues had already been exposed. Nirula has recorded that in sound young palms up to about seven years of the age females could lay eggs in the tender tissues of the crown. The life cycle, which is passed inside the palm, is completed in about 81 days on the west coast of India.

No parasite has been recorded in India, excepting a mite belonging to the family Pyemotidae, which is an external parasite on the pupae and adults of the weevil.

Four palm trunks used to protect the young palms from cattle are actually breeding the pest



Rhinoceros beetle grubs collected from the rotten base of one of the palm trunks

Left: *Devastation caused by rhinoceros beetle attack on a young palm.* Right: *An adult beetle extracted from a hole in the midrib of a leaf. Its presence was detected by the frass surrounding the hole*

Several insecticides have been tried for the control of this pest and a combination of 1% pyrethrin and 10% piperonyl butoxide, diluted to 1% in water, was found to give the best result. A young palm below the age of 10 would require about 1,000 c.c. to 1,500 c.c. injected into affected portions of the palm through a funnel. As a prophylactic measure the application of 5% BHC or chlordane, in mixture with sand, in the leaf axils was found satisfactory.

(*To be continued*)

Abstracted from FAO Plant Protection Bulletin, Vol. VI, No. 1, 1957.

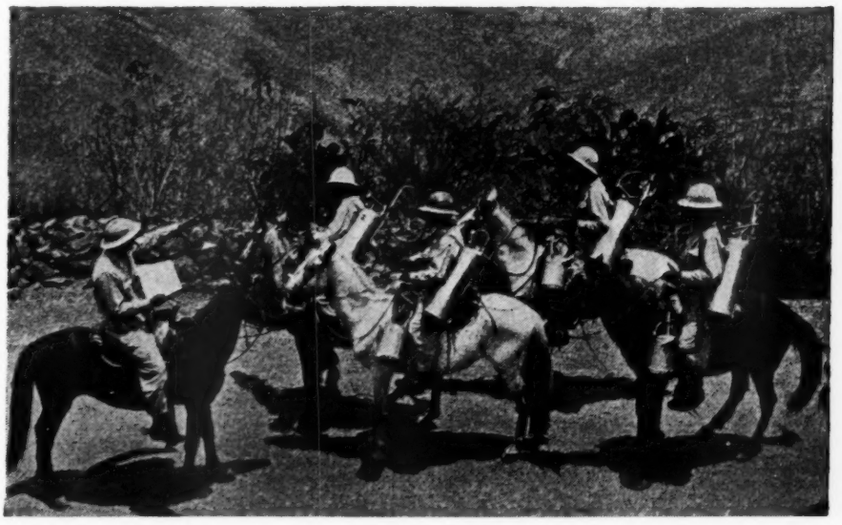
Control by Parasite

For a number of years the rather poor yield of coconuts per palm in Zanzibar has been attributed in part to the shedding of young vidaka (nutlets) as a result of damage by the sucking bug, *Pseudotheraptus wayi*, Brown (Heteroptera, Coreidae). Means of controlling this insect by insecticidal sprays have been under test for some years. While hopeful indications have in the past been obtained, it is not certain whether the increased yield that could be expected would justify the expense involved in spraying a crop as difficult to deal with as coconut palms.

The discovery in Zanzibar of a Hymenopterous egg parasite which attacks the eggs of *Pseudotheraptus* and which has proved amenable to laboratory breeding opens up the possibility of a biological control technique. A cheap method of biological control might be worthwhile even though the number of nuts were not greatly increased for it has been found that the nuts from areas, comparatively free of *P. wayi*, yield approximately 10% more copra, and the husks from nuts which have not been damaged by the insect are more suitable for coir fibre production.

This egg parasite has been provisionally identified as a member of the family Encyrtidae. Its life history and breeding is being studied by the entomologist in Zanzibar, and a preliminary paper is awaiting publication.

Unseen Enemies



A Mexican malaria-eradication team receives instructions. A still from the Shell film 'Unseen Enemies'

Made by the Shell Film Unit, London, 1959. Directed by Michael Clarke. Eastman Colour. Running time: 31½ minutes. 35 mm. and 16 mm. In English, French, Spanish, Dutch, Indonesian, Arabic and Japanese.

Poverty is a 'misery-go-round': disease, under-production, squalor, ignorance, malnutrition, more disease. People who are sick cannot produce food, nor can they earn enough to buy it. If they are poor as well as sick and hungry, they cannot better themselves. So they are under-nourished, and malnutrition breeds disease. And that is the fate of more than half the world's population and the chronic state of those countries called 'underdeveloped'.

Where to attack this problem? The film points the finger at disease, but reminds us of the other factors as well. If, with the resources of medical science at our command, we attack disease, we begin a process of change. Not only is appalling suffering relieved, but the people get a chance to improve their lot. For instance, the malarial season may coincide with the rice planting or the rice harvest. Then three out of every five land workers may be sick of the fever. Freed from malaria, five pairs of hands are available and the increase of food can be as high as 40%.

But intervention, whether it be by doctors or engineers, sprayers or flame guns, starts a train of events, and the train can never be reversed. As is so often pointed out, 'death control', by the removal of diseases, means more mouths to be fed. Babies do not die in infancy; they grow up, marry and multiply. Well over 50 million extra mouths will need rations in the course of this year. By 1980 the world's population will be, apart from cataclysm, 4,000 million; it may be more; it is unlikely to be less.

Unseen Enemies shows what can be done by insecticide spraying or mass inoculations with penicillin or systematic treatment of leprosy, trachoma or polio, but other advances tend to be slow. Schools, hospitals, houses, factories take time to build. Fertilisers, better seeds and farm machinery have to be provided if the land is to help feed these additional mouths. Farming, however, can be properly improved only if subsistence agriculture gives way to the production of surpluses that can be used to build up resources.

The film is a challenge to us all; it is strong meat not to be viewed by the squeamish or those who cannot face up to the facts of life—and death.

Unseen Enemies is available on free loan to schools, colleges and agricultural associations. Applications should be addressed to the Shell Co. in the country of residence.

The Dancing Daisies

Pyrethrum Cultivation in East Africa

S. HILL

This is the first of two articles dealing with the production of pyrethrum in East Africa and its uses—existing and projected.

The 'Dancing Daisies' seen in various stages of development

IT may be of interest to begin with a short history of pyrethrum before and after its introduction into Africa, for one of the most remarkable facts about this natural insecticide has been the manner in which it has more than held its own for so many years despite numerous vicissitudes and the introduction from time to time of competitive synthetic insecticides.

The first recorded mention of the insecticidal properties of this small, white, daisy-like flower is in *Chou Li*, the Records of the Rites of the First Century Chou dynasty in China—an account of the various departments of the Chinese Government some 1,900 years ago. It is believed that Persia was the first country where pyrethrum was generally used for insecticidal purposes (hence the name Persian flowers), and it is known that flowers were introduced into Dalmatia about 1828.

Since then they have been known by various names, including Dalmatian flowers, insect flowers and insect powder. The development in Dalmatia of *C. cinerariaefolium* proved a great advantage over the Persian variety and its possibilities were recognised by Japan, where, after the introduction of seed towards the end of the last century, a flourishing trade became established, with a virtual monopoly until 1935.

Today, the principal source of the world's supply of pyrethrum is East Africa, where less than 35 years ago no flowers grew. Its increasing cultivation in Kenya, Tanganyika and the Belgian Congo has been the result of close collaboration between the scientist and the practical farmer. The first pyrethrum to be grown in East Africa was brought to Kenya in 1928 by Captain Gilbert Walker, a soldier-settler with a scientific approach to new crops. Acting on information and advice from the Imperial Institute, Captain Walker obtained some seed from Dalmatia and virtually founded the pyrethrum industry, in the expansion of which his contribution in supplying seed from acclimatised strains was most important.

Previously there had been some importation from Japan, but with home-grown supplies, more attention began to be given to the field of application, in particular against coffee pests. Planters found that pyrethrum was successful against the coffee capsid bug (*Lygus Coffeae*, China) and the variegated coffee bug (*Antestia lineaticollis*, Stahl). By the end of 1932 production had increased to about 30 tons a year and the need for export arose.

Production in Kenya

Today the bulk of the crop is exported and it is estimated that a total of 8,000-8,500 tons of Kenya pyrethrum alone will be absorbed by the export market during the next production year, beginning on 1 July, 1960. The production potential in Kenya—the largest producer of the three East African pyrethrum-growing territories—has been estimated at 18,000-20,000 tons a year. The Pyrethrum Board of Kenya—the statutory board to which all growers deliver their flowers—anticipates that the market can, without difficulty, be expanded to take 10,000 tons of Kenya pyrethrum annually. Further expansion thereafter will depend largely upon the results of the research work now being carried out in the Board's laboratories at its headquarters at Nakuru, capital of the Kenya Highlands.

Pyrethrum, of which a great deal was produced in Kenya during the war, was badly hit immediately afterwards due to an accumulation of adverse factors, the most dangerous of which was the development of DDT and other forms of synthetic insecticides, comparatively cheaply produced. Sales were practically at a standstill in the U.S.A., which had formerly purchased more than 80% of the crop. However, with the development of synergists, pyrethrum became far less expensive to use and this factor, together with the establishment in 1958 of the Board's own sales organisation and a Technical Information Centre (APTIC), resulted in a

very large increase in the demand for pyrethrum in the U.S.A. and an expansion in its use in territories where little had been used before.

Environment and soils

Most pyrethrum in East Africa is grown at altitudes of between 6,000 ft. and 9,000 ft. The centre of the pyrethrum flower in its natural state contains the insecticidal constituents, known as pyrethrins, and it has been proved that a greater average pyrethrin content is generally found at higher altitudes.

The soils in most of the pyrethrum-growing areas in Kenya originate from volcanic rocks and are fairly rich and rather acid. The comparatively recent volcanic soils and ashes of the Belgian Congo and Mounts Meru and Kilimanjaro seem to offer the most favourable growing conditions. Work with fertilisers carried out by the officers of the Kenya Department of Agriculture lately have confirmed that responses to phosphates are only obtained on soils with a fairly low base-exchange capacity, found in the higher areas. The action of lime is not so well defined and requires further study.

During the early days of its introduction to East Africa—in the great depression of the 1930s—the hard-hit European farmer found pyrethrum a great boon. Nowadays it is also a rewarding crop for African farmers, an increasing number of whom are finding it an excellent cash crop suited to the higher areas of, for example, Kikuyuland and Kisii. The work entailed in the planting, weeding and picking of the crop requires a great deal of labour and attention, hence the pyrethrum grower expects to get a very fair return. His main consideration is to produce the maximum yield of pyrethrins per acre, since he is paid according to pyrethrins content, and he must concentrate both on the yield of flowers and their content.

At the cooler and higher altitudes of 8,000 ft. and over, 800 to over 1,000 lb. of dry flowers per acre can be obtained with careful management. Yields are generally best during the second and third years, after which they gradually fall off. The pyrethrins content tends to decrease with the age of the plant and growers find it advantageous to rotate different crops, such as cereals or grass, with their pyrethrum, which, dependent upon local conditions, should ideally be uprooted after about two or three years—or sometimes four.

An African-owned pyrethrum farm

Weeds and pests

Inefficient weeding is one of the worst major causes of reduced yields and there is as yet no practical implement able to deal with weeding between the plants, which has to be done by hand constantly and throughout the growing season, particularly during the rains. Before the initial planting the land must be thoroughly cleaned of weeds, of which the worst variety are the stoloniferous grasses, such as blue couch, and sorrel. Grasses which spread by underground stems are fatal to the plants and have to be removed with forks as soon as they appear.

Insect pests which can cause considerable damage to the crop are mainly thrips and red spider mite. Thrips have attacked the crop for a number of years, but there was a particularly severe attack during the 1959 season. Red spider mite has only lately become a menace, but has caused considerable damage in a short time.

Thrips are small, elongated yellow or grey insects which, once airborne, are liable to be caught in up-currents and blown many miles. The eggs, laid in the leaves of the pyrethrum plant, are most difficult to find; they hatch out, start to feed and themselves lay eggs, in as short a space as three weeks. In many parts of the world the species is known as the onion thrips and can completely ruin an onion crop. It will also attack many other plants, including chrysanthemums and other plants of the daisy family.

DDT and dieldrin have proved effective against thrips and the whole field is usually sprayed by a tractor-mounted sprayer. Unfortunately, it has become evident that, by using some insecticides persistently, the incidence of red spider mite is aggravated and the eventual answer will probably be the use of organo-phosphorus insecticides, experiments on which are in progress.

The red spider mite is about the size of a pin-head and is red or pinkish with small yellow legs. The Kenya Department of Agriculture is at present working on the use of insecticides to combat this pest. A simple quantitative sampling technique for identifying thrips in the early stages has also been evolved by the Department and growers who have used it have been able to catch the infestations before the plants show damage.

Harvesting and drying

Picking the crop requires some experience. Although the pyrethrins content is at its maximum when the flower florets commence to open, it has been found that, by strip-picking down to the petals' horizontal stage, at 14-day intervals, the yield of pyrethrins can be increased. Stripping

A typical field of full-grown pyrethrum daisies at harvest time

takes place at intervals of between two and three weeks, according to the season and rainfall, and careful supervision of the pickers is essential. An average picking by one person in a day is 25-30 lb. of fresh flowers, though some individuals can pick up to 70 lb.

When the flowers come in from the field they are spread out on trays to start drying out the superficial moisture before being put in one of the several types of drier recommended by the Drier Sub-Committee of the Pyrethrum Research Advisory Committee. The drying operation—as with tea or coffee—is a crucial process in the preparation of the crop and involves a sizable outlay by the grower and, again, close supervision of labour. When dry, the average weight of 4 lb. of fresh flowers is about 1 lb. The dried flowers are then cooled and packed in bags for delivery to the Pyrethrum Board, where samples are taken and sent to the Board's chemical laboratories for analysis of pyrethrins content and the grower paid accordingly.

Breeding and selection

In the field of agronomic research officers of the Kenya Department of Agriculture are engaged continually on the breeding and observation of new varieties. For example, in the year ending on 30 June, 1959, a large number of single-plant selections were under observation at various plant-breeding stations and new hybrids and other varieties were tested in 20 yield trials scattered over a large part of the pyrethrum-growing area. The seed production areas were enlarged and a large poundage of seed delivered to the Pyrethrum Board of Kenya for distribution to growers. This year a number of new seed production fields are being started which will widen the choice of pyrethrum varieties.

Organisation of production

In the current production year there are 938 growers licensed by the Pyrethrum Board of Kenya. Included in this figure are 20 licences issued to African co-operative societies, representing a large number of small growers. In the Kisii area of Nyanza alone there are some 12,000 with a total acreage of 5,000-6,000, yielding an average of about 350 lb. of flowers an acre. Local agricultural officers co-operate and advise on problems of cultivation and African growers obtain seed from the Board through their local co-operatives.

The Board issues production licences at the beginning of each year, based on a forward estimate of sales and stock requirements during the coming sales period. This year it is budgeting on a 30-40% increase on the total tonnage licensed last year. The Board is composed of elected regional representatives of European growers and nominated African representatives and commercial and Government-nominated members.

It is hoped to include the second part of this article in the September issue.

New Pyrethrum Varieties

Two new varieties of pyrethrum with a high insecticidal content have been developed at the Kenya Government's agricultural research station at Molo, 8,250 ft. up in the White Highlands.

Dr. U. Kroll, the Senior Pyrethrum Officer in the Department of Agriculture, who is in charge of the Molo station, has been working on the development of new strains there for 15 years. Of his two latest varieties, C45 will produce flowers containing more than 1.7% pyrethrins between 7,000 and 8,500 ft. above sea level, and M31 about 1.6% between 7,000 and 9,000 ft. These strains, with many others suited to various conditions, are sold to local farmers in the form of seed or 'splits', a service which is becoming increasingly popular.

The total output of seed at Molo has increased from 2,032 lb. in 1958 to 5,234 lb. in 1959.

Melittomma in Seychelles

A report has been received that the Melittomma beetle, which was first reported in 1904 and has since caused increasingly severe damage to coconut palms in the Seychelles, has been controlled and almost eliminated on Praslin, one of the islands of the group.

The pest is very insidious in its attack and generally the first warning is when the palm falls and then it is too late. Experts can recognise the palms under attack by the extrusion of very tiny pyramids of frass and then by beating the palm with a stone and listening for the angry buzz of the beetles within.

A campaign begun last November by Dr. I. W. B. Nye, an entomologist, has shown that this insect can be rapidly killed with a mixture of creosote and coal-tar. Despite heavy infestation, very few trees have fallen since this treatment was begun.

Herbicides in Sisal Cultivation—I

S. D. FLEMING, B.SC.*

In the course of two articles the author will review the progress made over the past four years with herbicides in sisal, since chemical grass and broad-leaved weed control has assumed considerable importance in the mechanisation of the industry.

SISAL was first introduced into East Africa in 1893, when 62 plants were imported to start an industry which is today the source of a significant part of the revenue of the country.

The progressive nature of the sisal industry is well indicated by a comparison between production and acreage figures for 1946 and 1958.

Year	*Acreage*	*Production Tons*
1946 ..	199,000	27,000
1958 ..	265,000	46,000

This represents an increase in fibre production of 70% from an acreage increase of only 30% and it is the opinion of the Sisal Research Station in Kenya that production with existing varieties of sisal could be doubled through the use of advanced production methods.

New hybrid varieties

The recent advent of hybrid 11648 (from selections made by G. Lock at the Tanganyika Sisal Planters' Association Research Station at Milingano) has placed new emphasis on the need to intensify the cultivation of sisal as a crop. Such emphasis is primarily concerned with the exploitation of the full potential of the new hybrid plant and when it is considered that it will probably produce up to 15 or 20 tons of fibre per acre in a cycle it is apparent that the use of improved methods of cultivation, including irrigation and the use of fertilisers, insecticides and weed-killers, must be employed to the full if maximum benefit is to be gained from this new advance.

African women carrying knapsack sprayers for the application of herbicides in the sisal bulbil nurseries

Total production will not necessarily be doubled, since the increased yield will allow the use of smaller and more efficient areas of cultivation to produce the same total quantity of fibre.

This has altered the whole outlook of the sisal industry, which is now becoming increasingly aware that the time has come to introduce new methods of cultivation and production, and to prepare for the greater mechanisation of the crop against the time when this new hybrid variety is established throughout East Africa.

Future trends

Modern methods of production in the factory, with attendant progress towards lower transport costs, have already led to a more economic production of fibre, and further economies must come from reducing costs in the field and in the nurseries. Research workers are satisfied that successful production must commence with well-grown healthy plants from the bulbil nursery, and this will become increasingly important with the reduction in total acreage.

Present methods are not entirely satisfactory and the benefits to be obtained from the use of modern methods in the nurseries, including the use of herbicides, will be more than repaid by the vigour and uniformity of the plants which are put out into the field.

Mechancial and hand weeding

The increasing difficulties experienced by sisal growers with the employment of hand labour to control weed growth, coupled with the serious crop losses in both nurseries and the field which result from the use of hand labour, have encouraged the development of alternative methods of weed control.

In the field the expenditure of large sums of money in newly planted areas for the hand weeding of annual and perennial grasses has been gradually reduced with the introduction of mechanical implements such as the 'Gyramor' and various types of rotary slasher. These machines cannot, however, cope with grass weeds which are growing between the sisal plants or directly alongside them, so that alternative methods to overcome this problem are of great importance. Once the sisal plants have grown to the stage where regular cutting of the leaf is required it becomes very difficult for

* Fisons Pest Control (E.A.) Ltd., Nairobi, Kenya

hand weeding to control grasses adequately by cutting.

Grasses such as *Digitaria scalarum* (African couch grass), *Imperata cylindrica* (lalang), broad-leaved weeds such as *Mucuma pruriens* (Buffalo bean) and Bonamia creeper, together with bush species of the general *Acacia* and *Combretum*, have all responded to the action of various herbicides, and practical control can now be obtained with a considerable saving in time and labour, and hence cost.

An example of how a herbicide can come to the aid of the sisal planter is seen from the way in which MCPA has successfully controlled the spread of buffalo bean, locally known to the Africans as *Upupu*. This highly aggressive weed develops rapidly in field sisal, climbing over the plants, making cutting operations well nigh impossible; the presence of very fine hairs on the ripening seed pods of this plant, which blow off at the slightest touch and cause unbearable irritation to the skin, often results in labourers refusing to cut leaf from areas infested with buffalo bean.

A simple treatment with MCPA applied by hand sprayers at low volume, prior to the flowering of the bean plants, has given a very high degree of control and complete eradication has been obtained where concerted programmes of MCPA treatments have been followed.

Hand cleaning in sisal bulbil nurseries can cost up to £36 per acre annually and it must be borne in mind that this expenditure does not take into account the losses which directly result from the practice of hand weeding; the normal method of overcoming these losses is to plant an acreage of nursery in excess of that actually required, making allowance for the expected damage.

The use of persistent pre-emergence herbicides, particularly the new triazine compounds, such as simazine and atrazine, in bulbil nurseries has shown that considerable saving in direct costs can be achieved and, even more important, the losses in nursery population can be cut down to a negligible figure. Direct costs from the use of these herbicides are in the region of only £10 per acre per annum and planters using these herbicides can budget more accurately for the ratio of acres of nursery to acres planted out (roughly in the proportion 1 : 14).

In bulbil nurseries losses of up to 40% of the original stand of sisal bulbils are by no means uncommon; these losses arise from the considerable damage to young plants caused by hand labour when removing grasses and broad-leaved weeds in the rows of bulbils. A programme of continuous replanting after each weeding operation has to be maintained if the planting programme in the field is to be adequately carried out.

In many instances it has proved economically impossible to overcome weed problems by manual or mechanical means; for this reason otherwise good land has had to be given over to fallow and fresh sites have had to be selected for nurseries. Examples of this are the problems of couch grass and lalang in Kenya and Tanganyika respectively, for which hand-weeding costs are so high that it is not considered feasible to dig out these grasses.

Use of herbicides

Trial work with herbicides commenced in East Africa in 1951 and tests on a wide variety of materials have been carried out at the Sisal Research Stations in Kenya and Tanganyika. Considerable progress was made and today the more progressive sisal estates are actively engaged in developing the use of herbicides as an integral part of the overall mechanisation programme. Industry has played an important role in this development by placing men and equipment at the disposal of the planters to carry out field evaluation of the results obtained in small plot experiments at the two research stations.

Particular instances where the use of herbicides can play an important part in the cultivation of sisal are in the control of pernicious grass and broad-leaved weeds which prevent the growth of sisal bulbils in nurseries or cause difficulty in the harvesting of sisal leaves after the establishment of the crop in the field.

The use of herbicides, such as sodium 2,2-dichloro-propionate, applied by hand sprayers with a directional nozzle is becoming widespread, and it has been found in practice that highly efficient control of grasses can be obtained with this chemical at a cost, for localised spot treatment, of as little as 16s. per acre

Scrub control

Since sisal estates are spread largely over areas which at one time were bush land, the reversion of the land to heavy bush growth towards the end of the sisal plant's cycle is another of the problems which faces the planter.

In the latter years of the cycle, when the yields of leaf are declining, it does not pay the planter to spend very much on keeping the land clean and, in any

Grass and broad-leaved weeds may make it difficult to harvest the sisal leaves

case, the mature sisal plants are well able to compete with weeds and grasses growing among them. Bush growth, however, is another matter, as it tends to make the harvesting of leaf difficult, slower, and thus more costly.

Herbicides in the form of mixtures of 2,4-D and 2,4,5-T esters have again come into the picture and highly encouraging results are being obtained in Tanganyika, where this problem is seen at its worst. By the use of 2,4-D and 2,4,5-T esters, the need for laborious and expensive stumping of brush in mature sisal can now become a thing of the past, with considerable saving in expenditure.

With the increasing practice on sisal estates of keeping quite large numbers of cattle for beef production, the problem of bush control in the grazing areas has become sharply outlined. Trials in Tanganyika have shown that it is possible to clear quite dense secondary bush by a combination of arboricides and hand labour, at a cost less than half that of clearing by hand labour alone.

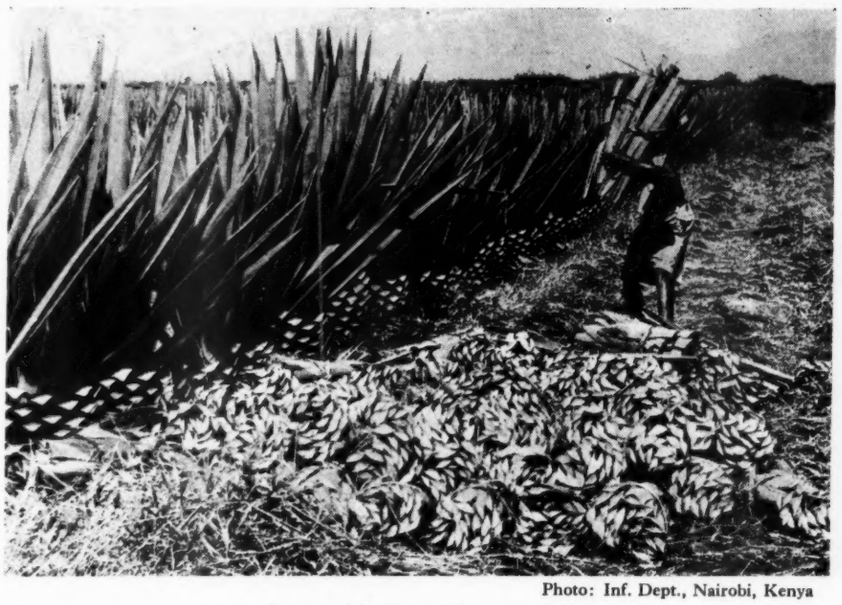


Photo: Inf. Dept., Nairobi, Kenya

Cut sisal leaf awaiting removal

From the above it will be seen that the application of herbicides in sisal offers great benefits to the industry in East Africa and is contributing to the rapid progress being made in improvement of the crop.

(*To be continued*)

Wine from the Desert

Wine from Cyrenaica was greeted in Europe as 'a gift from the gods' in classic times, when first Greece and then Rome were dominant in the Western world, and Cyrenaican table grapes were found at many a Bacchanalian feast. In later ages viticulture disappeared in Cyrenaica and, in the course of centuries, the desert sand buried the once-flourishing vineyards.

Re-establishing the industry

Today the Libyan Government is trying to revive and re-establish the Cyrenaican wine industry, encouraged by the success of Italian colonists who started planting large vineyards in the early part of this century and achieved excellent results. The Italian grape growers established an experimental station at Balange, near Cyrene, where they tested 22 varieties of table grapes and 14 varieties of wine grapes, but all these plantations were abandoned during the Second World War and the records of the work were lost.

Experts from the U.S. Operation Mission and FAO have helped farmers to improve old plantations and to plant new vineyards, mostly around Messa, Beida and Gubba. Last year's production reached 1,400 tons of grapes. Of these, some 1,100 tons are black (mostly of the Alicante or Garignaro varieties) and 300 tons are white grapes of mixed Italian and Sicilian varieties. Grape production is now increasing yearly by 100 tons.

The Beida wine factory, built by the Italians in 1934, is now run by a private company under contract with the Government. The factory pays a fixed amount per kilo of grapes and makes no distinction between qualities. It checks the maturity of the grapes and, by analysis for sugar content, decides upon the time of vintage. The Government provides crates to encourage the farmers to gather and transport the grapes in good condition.

Quality of the wine

Cyrenaican wine has an alcohol content of about 16-17%, at which point the action of fermentation ceases and the sugar that has not been converted into alcohol remains in its natural state. This makes the storage and the transport of the wine easier, as no chemical treatment is required.

The red wine is bright ruby, very rich, velvety, palatable, full-bodied and strong. The white is clear, golden yellow, semi-dry, very rich and a bit rough, with a fruity taste. Both are considered to be of better quality than the so-called 'table wines'.

Wine for export

Since very small quantities are consumed by the Libyans, Cyrenaica must find export markets—a difficult task in view of wine surpluses. It is hoped to make Libyan wines more competitive by reducing production costs in the near future. Meanwhile, efforts are concentrated on the production of table grapes for the Benghazi and Tripoli markets, which could absorb larger quantities than they do now.

This year about 30,000 more table grape vines will be planted. Their production will not only increase the quantity of fresh fruit for the domestic and export market, but will also add to the income of farmers and improve their own diets, as, on average, they do not consume more than 22 kilos of fresh fruit per year.

Rust Disease of Coffee

2—Spread of the Disease

R. W. RAYNER, B.A., A.I.C.T.A.

According to the author of this article, coffee rust has spread east, south and west from its original home in Abyssinia and Uganda, and now is a threat to the Americas, which are at present free of the disease.

THE fungus *Hemileia vastatrix* first became known to Western science in 1869, when the Rev. M. J. Berkeley received specimens from Dr. Thwaites, of the Royal Botanical Gardens at Peradeniya, Ceylon. Coffee had been cultivated in the island since about 1700 without the disease having been noticed. Within five years from its first observation in the mountainous region in the south-east it had spread so that no plantation in the island was free from it. The average yield before its appearance had been about 4.5 cwt. per acre. By 1878 the yield was down to 2 cwt. and the resulting monetary loss has been estimated at £2 million per annum.

Marshall Ward was sent out to investigate the disease in 1880, but so much damage had already been done that it was not possible to avert disaster and plantations were soon being abandoned. Although Ward made a brilliant investigation, plant pathology was still too much in its infancy for satisfactory control methods to be found. In fact, even today it would be very difficult to control the disease in Ceylon, as the conditions are so propitious. The very rapid increase of the disease to epidemic proportions in Ceylon makes it probable that the disease had previously been absent and that in some manner it had found its way to the island.

Soon after the disease had been discovered there, country after country reported its arrival (see Table 1).

Original home

Wellman[6] has explored the question of its original home and has produced weighty circumstantial evidence that it was either Uganda or Abyssinia. Abyssinia was, without much doubt, the original home of Arabian coffee, and Robusta coffee was probably native to Uganda and the adjoining territories. It is therefore highly likely that *Hemileia vastatrix*, which is principally a disease of these two varieties, should have originated in the areas in which they are native. It appears that Fischer almost certainly saw the disease in the region of Lake Victoria in 1885, and it would seem to have been present there for many years, according to plant pathologist Small. Ciccarone in Abyssinia found evidence that it had been known there for very many years, for it has special names both in local dialects and in Amharic, and this suggests it must have been present there for a very long time.

Photo: Shell

Ivory Coast. A coffee bush infected with the disease. The loss of leaf is a very marked feature

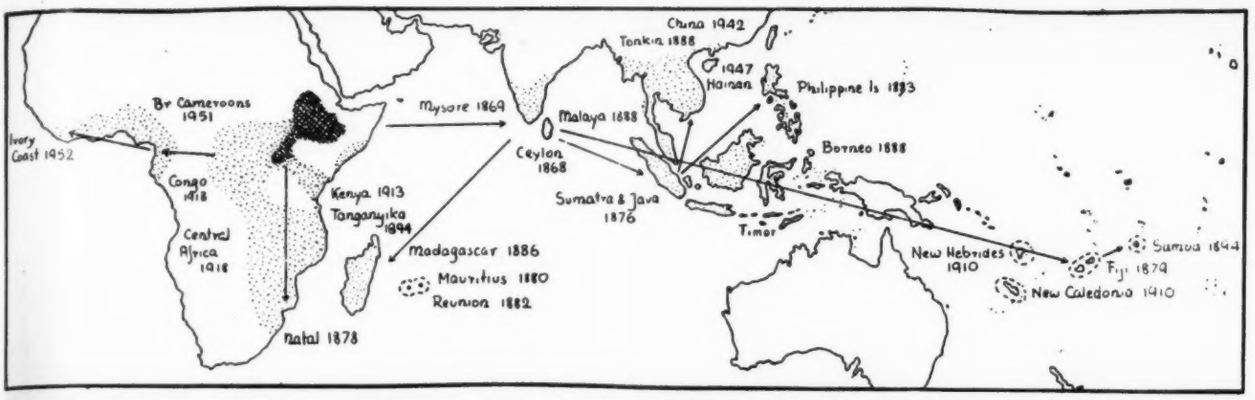
Table 1

First record of the appearance of coffee rust

1868	..	Ceylon
1869	..	Mysore, S. India
1876	..	Sumatra and Java
1878	..	Natal, S. Africa
1879	..	Fiji
1880	..	Mauritius
1882	..	Reunion
1883	..	Philippine Islands
1886	..	Madagascar
1888	..	Tonkin, Malaya and Borneo
1894	..	Samoa and Tanganyika, E. Africa
1910	..	New Hebrides and New Caledonia
1913	..	Kenya, E. Africa
1914	..	Transvaal, S. Africa
1918	..	Central Africa, including Rhodesia and Belgian Congo
1940	..	Mozambique
1942	..	Eastern China
1946	..	Zanzibar
1947	..	Hainan
1951	..	British Cameroons
1952	..	Fernando Po, Ivory Coast and Dahomey
1953	..	Sudan
1954	..	Togoland

Its spread

How it arrived in Ceylon is not known, but it would seem highly probable that it was blown there by the south-west monsoons from the Horn of Africa. Then the disease spread rapidly to almost all Eastern countries



World distribution of coffee disease, Hemileia vastatrix, *showing the main trends of the movement, east, south and to the west. The original home is cross-hatchered and the areas subsequently invaded are stippled or ringed round*

which produce coffee, and in 10 years it was recorded from Fiji.

At the same time, on its way southward it was reported from Natal, South Africa, in 1878. By 1904 it is reported to have ruined coffee-growing in the Transvaal. Surprisingly, it appears to have reached Eastern and Central Africa rather later, but this may have been because of the later introduction of coffee into these areas, and perhaps also because many of them were isolated. Thus in Kenya it was not reported until 1913.

Of recent years it has suddenly expanded its range westwards, being first reported in the British Cameroons in 1951, and in 1953 it was already in the Ivory Coast, from where it now threatens the New World. Latin Americans have reason to look at the map of the winds of the world with great disquietude, for the north-east trades blow down along the coast in this part of Africa and then out across the Atlantic towards them.

Rust is, as yet, absent from the New World, though on one occasion it is known to have been accidentally introduced on some seedlings. This was in Puerto Rico in 1907, but immediate messures were taken to destroy it and, fortunately for the vast areas of coffee in Central and South America, these were successful.

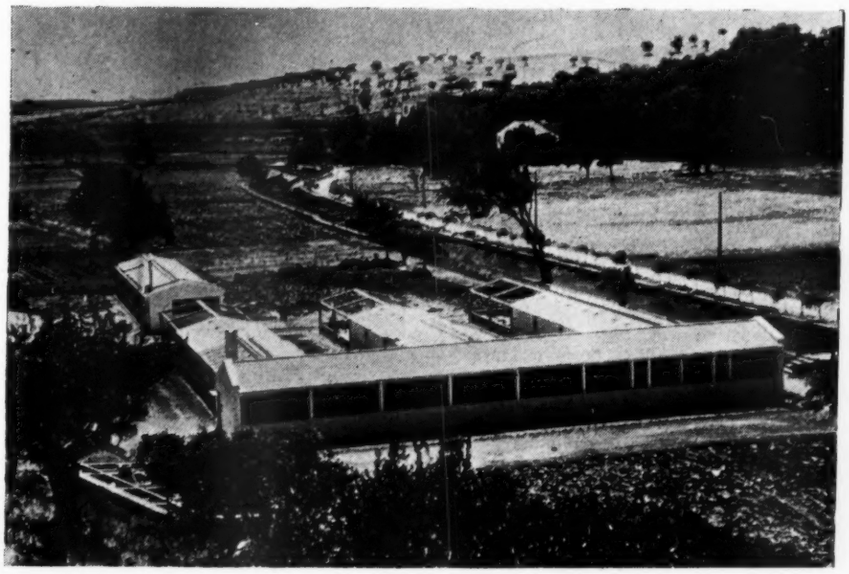
Trail of destruction

As the disease went from country to country so it left a trail of destruction. Wellman[6] has written a graphical description of its depredations and some of the following data is taken from his paper. Java was the next to suffer after Ceylon. Before the rust arrived, this country was producing 60,000 tons annually; five years later it was 40,000 and in another five years 20,000 tons. Now very little Arabica coffee is cultivated and the lower quality, but more resistant, Robusta is grown instead. In Uganda the losses are estimated at 30% of the crop. In the Philippines, coffee was the most important export before the arrival of the rust. A few years later the plantations were abandoned. In New Caledonia, after only two years, half the crop was lost.

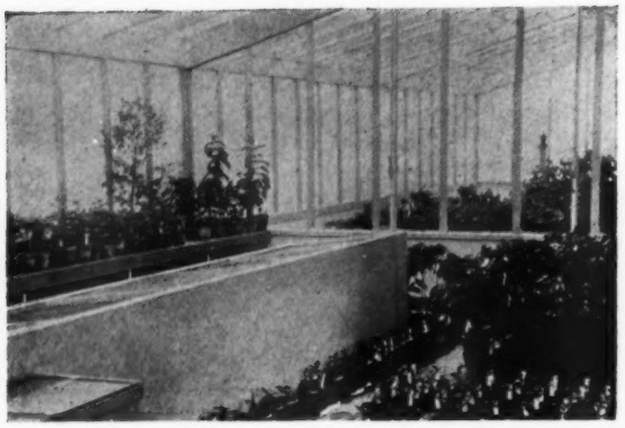
The whole economy of many of these countries was shaken. Big estates reverted to jungle, rich families became poor and many had to emigrate, and the East became no longer the centre of world coffee production, which now moved to Central and South America. In the East people turned to the cultivation of other crops, amongst them tea. It is in no small measure due to *Hemileia vastatrix* that the British are now a nation of tea drinkers.

Threat to the Americas

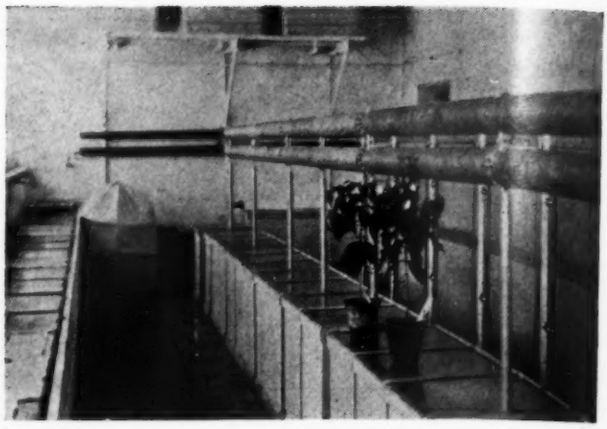
The disease has never reached the vast New World coffee estates, but it has crept very much closer of recent years and the possibility of it reaching them, in spite of stringent quarantine regulations, cannot be ruled out. There can be no doubt that if it did so there would be a disaster of the first order. Climatic conditions are such that the disease would certainly sweep through many areas like a fire. In Central America and northern South America conditions would appear to be particularly favourable and D'Oliveira[7] has shown that the principal varieties cultivated there are all highly susceptible to rust.



The Coffee Rust Research Station at the National Agricultural Station, near Lisbon, Portugal. In the foreground are the laboratories; to the rear are the glasshouses



Some of the collection of coffee varieties at the Coffee Rust Research Station. Propagating frames are seen in the centre of the picture



The inoculation chambers at the Coffee Research Station, where the plants are injected with the disease under controlled conditions

The menace is so great that it has prompted the Foreign Operations Administration of the U.S.A. to take special measures to further research into means of combating rust before disaster occurs. A special fact-finding expedition was organised in 1952 to visit the main coffee-growing countries of the world where rust occurs. This was led by Drs. Wellman and Cowgill from the Inter-American Institute of Agricultural Science, Turrialba, Costa Rica. From this an international search for coffee varieties which can resist the attack of rust has developed.

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The third part of this article will deal with the problem of varietal resistance.

NOTE FOR CONTRIBUTORS AND AUTHORS

The editor welcomes authoritative articles and news items on agricultural machinery and agricultural methods, agricultural crops and new developments.

A short synopsis should preferably be included to assist the editor and the manuscript itself should be typed in double spacing with plenty of margin and on one side of paper only.

It should bear the name and address of the author and be accompanied by sharp photographs or line drawings with suitable captions.

Technical News

Articles in the June issues of some of the other journals of the Leonard Hill Technical Group include the following:

Automation Progress.—'Handling, Cutting and Drying of Wood in a Sawmill'.

Chemical & Process Engineering.—'Materials of Construction for Chemical Plant: Lead, by H. C. Wesson; 'Utilisation of Waste Sulphite' by Dr. A. E. Williams.

Dairy Engineering.—'How Plastics Serve the Dairy Industry' by A. Walker; 'Galvanised Steel for Dairy Plant and Equipment' by M. H. Davies.

Fibres & Plastics.—'Electronics in the Textile Industry'; 'Progress in Anti-statics for Textiles'.

Food Manufacture.—'World Food Supplies—V. World Requirements' by Dr. Francis Aylward.

Manufacturing Chemist. — 'Flow Measurement and Control' by A. Linford.

Paint Manufacture.—'Paint Industries of the Outer Seven'.

Specimen copies of the above journals are available on application to Leonard Hill House, Eden Street, London, N.W.1.

Tobacco Wilt

A virulent disease, known as Asiatic-type Granville wilt, is threatening to wipe out the tobacco crop in the Acholi district of Uganda. The disease was first identified by the Department of Agriculture after it had destroyed one seedbed; then others were also found to be affected.

Research in Nematology

A new laboratory for research on soil nematodes—the free-living yet parasitic eelworms—is to be established at the field station of the Zoology Department of the Imperial College of Science and Technology at Silwood Park, near Ascot.

The serious economic effects of plant nematodes in agricultural production have aroused concern in recent years, not only in FAO circles, but also in Commonwealth countries.

Under Prof. B. G. Peters, who was appointed to a new Chair of Parasitology at Imperial College in 1955, work on this subject has been developing and a full-time one-year course in nematology was started in 1958.

The new laboratory is to be built and equipped at a cost of £30,000, half of which has been contributed by the Shell International Chemical Co.

Mountain Lands Research

A Tussock Grasslands and Mountain Lands Institute is to be established at Canterbury Agricultural College, Lincoln, New Zealand.

This Institute will investigate all aspects of the management of tussock grasslands and mountain lands, including the development of techniques to stimulate the growth of a more protective and stabilising cover of vegetation in high country, so as to mitigate soil erosion and the choking of river channels.

Sodium for World Crops

Survey of Investigations in Europe and America

JAMES DUNDAS, B.SC.

ONCE regarded as an inert substance having no part in the nourishment and growth of plants, sodium was found on investigation to be physiologically active. It is now recognised that sodium can substitute for potassium in many crop plants to a greater or lesser degree, thus increasing yields in conditions of potassium deficiency. Sodium is also known to be an important independent nutrient for certain crops, chiefly members of the beet and brassica families; even in the presence of abundant potash, such crops produce maximum yields only when sodium is also applied.

An essential element

That sodium is an essential element was first discovered in 1955 by the American workers, Allen and Arnon,[1] who showed it to be essential to the blue-green alga, *Anabaena cylindrica*. Two years later Brownell and Wood,[2] of the University of Adelaide, reported their discovery that sodium is an essential element for the higher plant, *Atriplex vesicaria*, a fodder plant of the beet family.

Sodium has become more important in agriculture as research has shed increasing light on the role which the element plays in plant nutrition.

The publication in Germany in 1960 of a major work, 'Das Natrium als Pflanzennährstoff' ('Sodium as a Plant Nutrient'), is evidence of the importance now ascribed to sodium. The author, Prof. Walter Baumeister,[3] of the Westphalian Wilhelm University, discusses, *inter alia*, the importance of sodium for beet and other members of the Chenopodiaceae, cabbage and other crucifers, celery, tomato, potato, flax and cotton, and its effect on certain physiological processes in the plant.

Sodium-potassium relationship

The relative extent to which sodium can substitute in part for potassium in certain crop plants is shown diagrammatically in Fig. 1. The degree of substitution is indicated by the height of the Na (sodium) column in relation to that of the K (potassium) column.

It will be seen that sodium substitutes to the greatest extent in celery and cotton, and in beet and other members of the Chenopodiaceae which are listed in the left-hand column. Next in proportion of substitution come cabbage and other crucifers, oats and celeriac in the second column from the left. Sodium substitutes to a moderate extent for potassium in asparagus, barley, wheat, tobacco, tomato, coconut, flax and other crops as shown in the second column from the right and to a small extent in a few other crops, such as lettuce, potato, rye and spinach, which are listed in the right-hand column.

These four classes correspond with those of Harmer and Benne,[4] who divided crops into four categories in relation to their response to sodium, *viz.* large or medium response in presence of sufficiency of potash (two left-hand columns), and medium or slight response in deficiency of potash (two right-hand columns).

Fig. 2 shows the crops for which sodium is an independent nutrient. They consist mainly of members of the beet family and the brassicas. Even in the presence of abundant potash

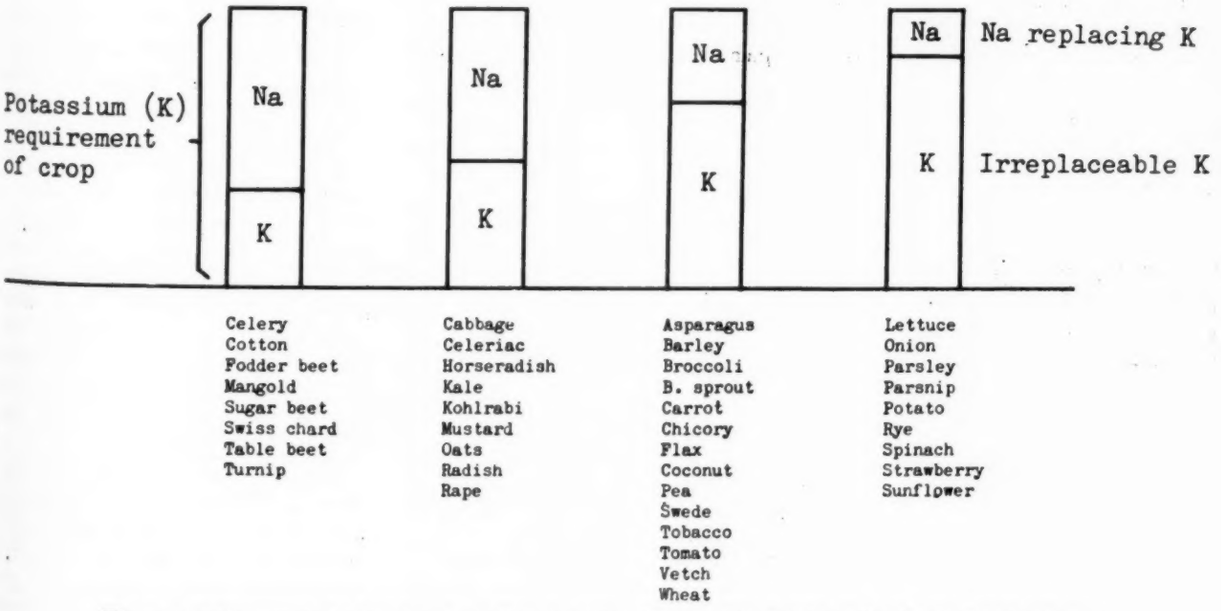

Fig. 1. Replacement of potassium by sodium in crops. The relative height of the Na (sodium) column shows the extent of replacement

these crops produce maximum yields only when sodium is supplied.

Role of sodium

A useful secondary characteristic of sodium in dry climates or dry weather is that it helps to prevent or decrease wilting, because it increases the turgidity of plants. Being highly hydrated, it clings tenaciously to water molecules.

Sodium plays an important role in the cultivation of crops in all parts of the world. It acts as an independent nutrient for sodium-loving plants, such as beet, brassicas and cotton, increasing their yields. In potassium-loving and other crops, *e.g.* cotton and barley, it partially substitutes for potassium, thus increasing yields in cases of deficiency of this element. With certain crops, including red table beet, tobacco, celery and flax, it improves quality. Instances of the beneficial role of sodium in three important world crops are given below:

Sugar-beet

Sugar-beet is a classic example of a sodium-loving crop. According to Adams,[5] sodium is the second most important plant food for the crop, and Russell[6] has said 'that sugar-beet has a definite sodium requirement if it is to give maximum yields'. Not only does sodium partly substitute for potassium within the plant, thus resulting in increased yields on potassium-deficient soils, but it also has a strong independent effect on yield, which operates even when abundant potassium is present.

Writing in the *British Sugar Beet Review* in 1950, Crowther and Garner,[7] of Rothamsted, stated that for sugar-beets and mangolds 'sodium nitrate can be regarded as a compound fertiliser supplying two plant nutrients, sodium and nitrogen. Since sodium can perform some of the functions of potassium within sugar-beet and mangold plants, sodium nitrate can be regarded for these crops as being almost equivalent to a compound fertiliser supplying nitrogen, sodium and potassium'.

No doubt the effect of sodium was the factor responsible for the good results given by nitrate of soda in the two instances mentioned below. Decoux *et al.*[8] report on a trial at the Belgian Institute for the Improvement of the Beet, in which a comparison was made of seven nitrogenous fertilisers applied a few days before sowing at 89 lb. per acre. The highest sugar yield, 66.7 cwt. per acre, was given by nitrate of soda. The yields given by the other fertilisers ranged from 60.1-66 cwt. per acre. Similarly, in a series of trials at 13 Danish State experimental stations[9] between 1930 and 1942 Chilean nitrate of soda outyielded four other nitrogenous fertilisers for sugar-beet. It gave a dry-matter yield increase of 13.66 cwt. per acre, compared with, 7.23 and 10.57 cwt. per acre with the other fertilisers.

Fig. 3. Autoradiograph of cotton leaves showing even distribution of sodium

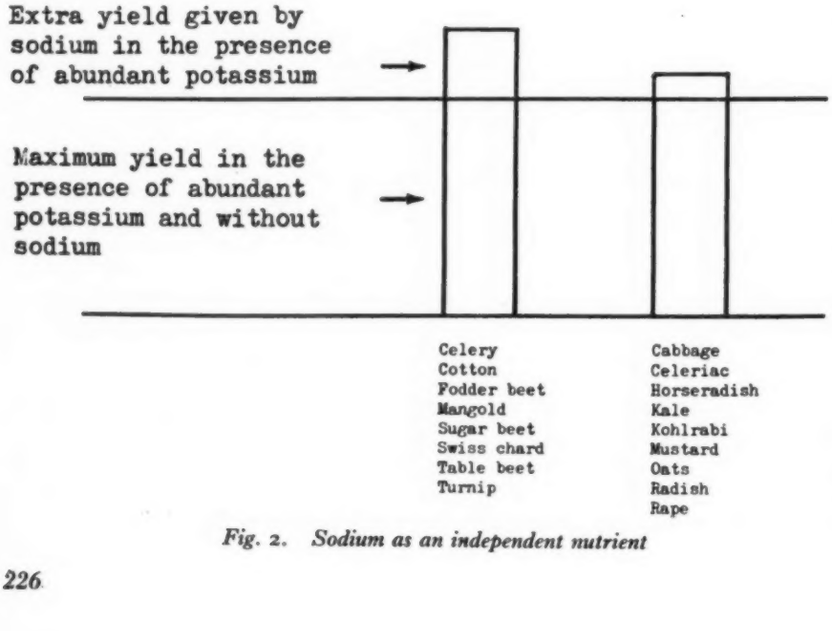

Fig. 2. Sodium as an independent nutrient

Cotton

Cotton is another important crop on which sodium has a very favourable effect. Investigations with radioactive sodium used as a tracer[10] have shown that the greater the response of a plant species to sodium the more uniform is the distribution of the ion throughout the plant. Cotton is a case in point, as is shown by Fig. 3, an autoradiograph of cotton leaves. In an autoradiograph only the radioactive element, in this case Na^{22}, shows up and it is evident that sodium is freely translocated by cotton and evenly distributed in the leaves.

In cotton sodium acts partly by substituting to some extent for potassium and partly by its independent effect. Joham[11] encountered the potassium-substituting effect in sand culture and solution culture experiments and others have observed it in the field. For

example, Cooper and Garman[12] in South Carolina showed that sodium can substitute for at least 25% of the potassium required by cotton and later studies by Cooper, Paden and Phillippe[13] suggest that sodium can substitute for up to half the potassium. They studied the effects of the sodium in nitrate of soda on yields on the grounds that this fertiliser is one of the most common sources of nitrogen in side dressings for cotton.

Table 1 gives the average yields of seed cotton per acre over 18 years, with and without sodium in the fertiliser. As the figures show, yield was greater with sodium than without at all rates of potash. The 30-lb. rate of potash side-dressed with nitrate of soda equivalent to 33 lb. of Na_2O per acre, produced more seed cotton than did the 45-lb. and 60-lb. rates of potash without sodium. These experiments indicated that for optimum yields, 60 or more lb. potash per acre was required where sodium was not included in the fertiliser and that little was gained by adding more than 30 lb. potash per acre, in combination with sodium.

The beneficial effect of sodium on cotton is reflected in many field experiments, in addition to those of Cooper, Paden and Phillippe mentioned above, in which nitrate of soda has outyielded other N fertilisers. For example, Marshall and Sturgis[14] found that 48 lb. N per acre as nitrate of soda and ammonium nitrate gave yields respectively 764 and 340 lb. per acre greater than the control, which yielded 918 lb. per acre.

Tobacco

In tobacco, a potassium-loving crop, sodium partly substitutes for potassium (see Fig. 4) and also improves quality, as the following examples show.

McEvoy[15] studied the interaction of sodium and potassium in flue-cured tobacco in sand culture experiments in Canada. The effect of sodium on yield was just below the level of significance. Sodium reduced potassium deficiency symptoms. It appeared that when potassium was deficient, sodium partly supplemented or replaced it in the nutrition of plants. In pot and field experiments on flue-cured tobacco in the U.S.A. several years later, Hutcheson *et al.*[16] encountered the same effects. When potassium was absent or supplied at low levels the presence of sodium delayed the appearance and lessened the severity of the symptoms of potassium deficiency. This led them to conclude that the sodium ion at least partially substituted for potassium in some plant process or processes, when potassium was in low supply.

Fig. 4. Tobacco leaves from pot trial with humic sandy soil without potash dressing. Left: *Potash deficiency symptoms in leaf from plant which received no sodium.* Right: *Normal leaf from plant dressed with Chilean nitrate of soda*

Table 1

Cotton yields with and without sodium in South Carolina

Sodium treatment (per acre)	*Potash treatment (per acre)*	*Average annual yield of seed cotton (per acre)*	*Average annual yield increase due to sodium*
	lb.	lb.	%
No sodium ..	—	261	
100 lb. Na_2O ..	—	445	70.5
No sodium ..	15	667	
100 lb. Na_2O ..	15	823	23.4
No sodium ..	45	960	
100 lb. Na_2O ..	45	1,090	13.5
No sodium ..	60	1,025	
100 lb. Na_2O ..	60	1,169	14.0
No sodium ..	30	987	
33 lb. Na_2O ..	30	1,059	7.3

Table 2

Duration of tobacco burn

Nitrate of soda ..	37.0 sec.
Cottonseed meal ..	34.0 sec.
Urea	29.0 sec.
Sulphate of ammonia	20.8 sec.

In five - year trials in Western Ontario[17], nitrate of soda gave the highest yield of Burley tobacco per acre, the highest grade index and the highest crop index. In cigar wrapper tobacco trials in Connecticut[18] nitrate of soda gave a greater average duration of burn than the other sources of nitrogen with which it was compared as table 2 shows.

This brief survey of sodium as a food for world crops has touched upon only a few typical examples of the role of the element in plant nutrition, but it shows the important part that this element, applied in the form of nitrate of soda, can play in increasing agricultural productivity.

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Agricultural Mechanisation in China

R. WESTGATE

A wooden five-row seed drill attached by a cable to a primitive man-powered winch

In this melting pot of teeming millions the ingredients are a strange mixture of primitive practices and modern methods, of ancient custom and advanced thinking.

MECHANISATION has not yet gone very far in China, but a Tools Reform Movement, intended as a step along the road towards large-scale mechanisation, has swept the country. In 1958, according to Liu Jiu-lung, Vice-Minister of Agriculture, some 350 million new and improved farm tools were in use in China, as well as large quantities of new drainage and irrigation equipment.

Farm implements

The peasants themselves have evolved many labour-saving devices for all kinds of farm work. Among the most important innovations are reapers, rice-transplanting machines and a method for drawing deep-ploughing implements by tow cables attached to winches.

The first important steps in the mechanisation of China's agriculture, taken during the First 5-Year Plan (1953-57), were the production of about 1½ million, 2-wheeled, double-share ploughs, 60,000 sowers, 20,000 horse-drawn harvesters, one million water wheels and drainage and irrigation pumps with an aggregate capacity of 360,000 h.p., many hand-powered threshing machines and a large number of farm vehicles.

In addition, a considerable amount of modern farm machinery and equipment was imported. This included 22,000 tractors (in 15-h.p. units), 970 combine harvesters and 17,000 tractor-drawn implements. Tractors have been imported from the U.S.S.R., Czechoslovakia, Hungary, East Germany and, of course, Britain. Modern machines were used to farm about eight million acres—yet this is under 3% of the total cultivated area.

Pumps

The Chinese, indeed, constantly emphasise that their country needs much more than tractors. The paddy fields, the steadily increasing irrigated acreage and the huge areas liable to flooding mean an enormous and urgent demand for drainage and irrigation machinery. A year ago the total capacity of such machines in China was not much more than 500,000 h.p.

By the end of the Second 5-Year Plan, *i.e.* in 1962, Chinese factories are expected to be producing enough drainage and irrigation machinery to ensure that the greater part of China's arable lands is irrigated. At present China has over 160 million acres of irrigated land (which is one-third of the world's total irrigated area) and

Combine harvesters at work on a State farm in Szechwan Province

about one-third of this is irrigated by wells.

Tractors

China has two major tractor plants —one is at Loyang and the other at Tientsin; other factories in various parts of the country are producing tractors suited to local conditions. Types in regular production range from 1.5-80 h.p. There are models variously designed for use in wet paddy fields or on dry land, in hilly or flat country and on large areas or for tiny plots. They include wheeled, track-type, universal and baby tractors.

With the exception of the 'Loyang' model (16-h.p., wheel-type) and the 'East Red' (45-h.p., track-type), both produced by the large new factory at Loyang, in Honan Province, and the 'Iron Bull 240' (40-h.p. diesel engined, wheel-type), made by the Tientsin tractor works, the remainder are all produced in widely scattered factories, working either independently or in association. The heaviest model in production is the 'Red Flag', an 80-h.p. track-type, made by a farm tool plant in Liaoning Province. China's total production of tractors last year was just under 1,000.

Farm machinery

Few statistics for the production of farm machinery in China are available, but it is known that in 1958 over 500 combine grain harvesters and about 750 power-operated threshing machines were produced. China's first self-propelled combine harvester was made early in 1958 at Harbin, north-east China. It is a 55-h.p. machine which can harvest 2½ acres of wheat or barley per hour. It can also be adjusted to harvest soya beans and can be adapted for power generation and for driving village rice mills.

Farm vehicles

Efforts are being made to meet the acute shortage of farm vehicles. In the Automobile Department of Kirin Engineering University a simple truck suitable for conditions in the countryside is being designed and produced. The prototype model has a 20-h.p. engine, wood is largely used instead of steel, and no alloys will be needed. The vehicle will have a loading capacity of 1½ tons and will run at 10-15 m.p.h. Subsequently the idea is that each rural commune will establish a plant to produce between 50 and 200 of these trucks a year.

A rice-transplanting machine, invented by a research institute in Nanking, being used for close planting, which is now being adopted throughout China

At the Changchum motor works China has been producing lorries since 1956, and the output last year was about 16,000 vehicles. This factory produces a 6-wheeler with a carrying capacity of 4 tons. It has a 6-cylinder gasoline engine which develops 90 h.p.

Rice machinery

Chinese engineers have for some time been developing special tractors for use in the paddy fields and two have been selected for mass production. One is a 35-h.p. machine and the other a 27-h.p. type. Both have bladed wheels and are described as light in weight, with good traction, adequate power and manoeuvrability. They can plough deep and can be adapted for operations on small plots.

Experiments have also been carried out with the refitting of medium and large track-type tractors for work on large paddy fields. In recent years four of the leading rice-growing provinces—Kiangsi, Kwangtung, Hunan and Anhwei—have been putting refitted tractors in the field at the rate of about 1,000 a year. Kiangsi Province leads in paddy field mechanisation with 500 tractors operating from tractor stations. The province has also developed the use of ploughs and harrows, mounted on tractors, for small paddy plots and is now trial-producing tools for transplanting and harvesting.

At the present time over 60 kinds of rice-transplanting machines are in use in China; all are of simple design—easy to make and to handle; some are hand operated, and others are drawn by horse or cable. The best, which was designed by an engineer at a research institute in Nanking, can be drawn either by horse or cable and operated by one man. It can transplant about 5 acres of rice a day.

Soya beans and wheat

One of the most industrialised provinces, Heilungkiang, in the north-east, has the most mechanised agriculture and is the largest producer of wheat and soya beans. Tractors and horse-drawn sowers have replaced most of the hand tools for the sowing of soya bean. For the last spring wheat sowing, farms in the province used some 1,000 tractors and 50,000 horse-drawn ploughs on over 1.6 million acres.

Areas in other provinces plan to mechanise farming industries during the next few years—water will be pumped by machinery, more and more tractors will be introduced, heavy transport will be motorised and subsidiary work like oil pressing and cotton ginning will also be done by machine.

Agricultural chemicals

The modernisation of Chinese agriculture within the next 15 years also involves the extensive use of chemical fertilisers and insecticides. The production of fertilisers in 1958 amounted to 811,000 tons, excluding ammonium nitrate, and production is planned to reach about 10 million tons a year by 1962. An output of 30 million tons a year is even considered to be possible when fertiliser plants are established in the provinces.

So far 12 major types of insecticides have been developed in China. During the First 5-Year Plan they were used to destroy pests on 250 million acres, resulting in an estimated saving of nearly 6 million tons of grain and 200,000 tons of cotton.

Summing up

The main emphasis will be on pumps, tractors and electrification, and thereafter on machines for sowing, transplanting, harvesting and husking; small machines for processing and transporting farm produce; mowers and shearing machines for the pasture lands (principally in Inner Mongolia); and special machines for cash crops—soya beans, peanuts, ramie, jute, rapeseed, tobacco, sesame etc.

Improving the work tools of China. Ball bearings being fitted to farm vehicles. In 1958, 120 million sets of ball bearings were produced, mostly in village workshops

Nevertheless, steps are also being taken to increase the animal traction power in agriculture. This year the number of big livestock (oxen, horses, donkeys, mules and camels) is to be increased to 90 million, or 6% more than last year.

The factors to be taken into account are local prejudice and habits, the operating conditions and the types of power available in any given region. Machines driven by wind or water are to be designed for certain places. Because of the lack of oil, diesel engines are not to be manufactured in quantity, and smaller and more mobile power units will be favoured.

Old-type farm tools are not to be totally discarded, but improved versions are to be manufactured in small implement factories which are going to be set up in every administrative region or county. During 1958 over 40,000 farm tool plants and workshops were established to make such improved tools.

Coming Events

Grasslands.—The 8th International Grassland Congress will be held at Reading, England, from 11-21 July, 1960. Enquiries and requests for application forms should be addressed to the Secretary, 8th International Grassland Congress, Reading, Berkshire, England.

Rural Extension.—The 8th International Meeting on Methods and Programme Planning in Agricultural and Home Economics Extension is to be held at Wageningen from 5-29 July, 1960. Further information from the Director, International Agricultural Centre, 1, Generaal Foulkesweg, Wageningen, Netherlands.

Analytical Chemistry. — A Symposium on 'Analytical Chemistry in the Service of Agriculture', organised by the Midlands Section of the Society for Analytical Chemistry, will be held at Nottingham University on 14 and 15 July, 1960. Registration forms may be obtained from Mr. C. A. Johnson, B.SC., B.PHARM., F.P.S., A.R.I.C., Standards Dept., Boots Pure Drug Co. Ltd., Station Street, Nottingham, England.

Plant Protection.—An international meeting on Organisation and Methods of Plant Protection is to be held at Wageningen from 1-26 August, 1960. The meeting, designed for senior and junior officers of Plant Protection Services, Advisory Services, Experimental and other Research Stations, is organised by the International Agricultural Centre with the support of the Netherlands Ministry of Agriculture and Fisheries.

Further particulars may be obtained from the Director, International Agricultural Centre, 1, Generaal Foulkesweg, Wageningen, Netherlands.

Agricultural Co-operation. — The British Council, in association with the Plunkett Foundation and the Federation of Agricultural Co-operatives of Great Britain and Ireland, is organising a course in agricultural co-operation at Cropthorne, Worcestershire, from 14-27 August. Applications should be made to the Director, British Council, 65 Davies Street, London, W.1.

Agricultural Exhibitions

Germany.—An Agricultural Exhibition is to be held at Saarbrucken from 23 April-21 October. Further information from Ausstellungstechnische Leitung und Organisation Stadtverwaltung, Saarbrucken.

The National Agricultural Show takes place in Stuttgart from 24 September-2 October. Information from Stuttgarter Ausstellungs G.m.b.H., Am Kochenhof 16, Stuttgart-N.

England.—This year's Royal Show will be held at Cambridge from 5-8 July. Details may be obtained from the Secretary, Royal Agricultural Society of England, 35 Belgrave Square, London, S.W.1.

The Great Yorkshire Agricultural Show takes place in Harrogate from 12-14 July. Information from the Yorkshire Agricultural Society, Cliftonfield, Shipton Road, York.

N. Rhodesia.—An Agricultural Show will be held at Lusaka from 30 July-1 August. Further details from the Northern Rhodesian Agricultural Society, P.O. Box 333, Lusaka.

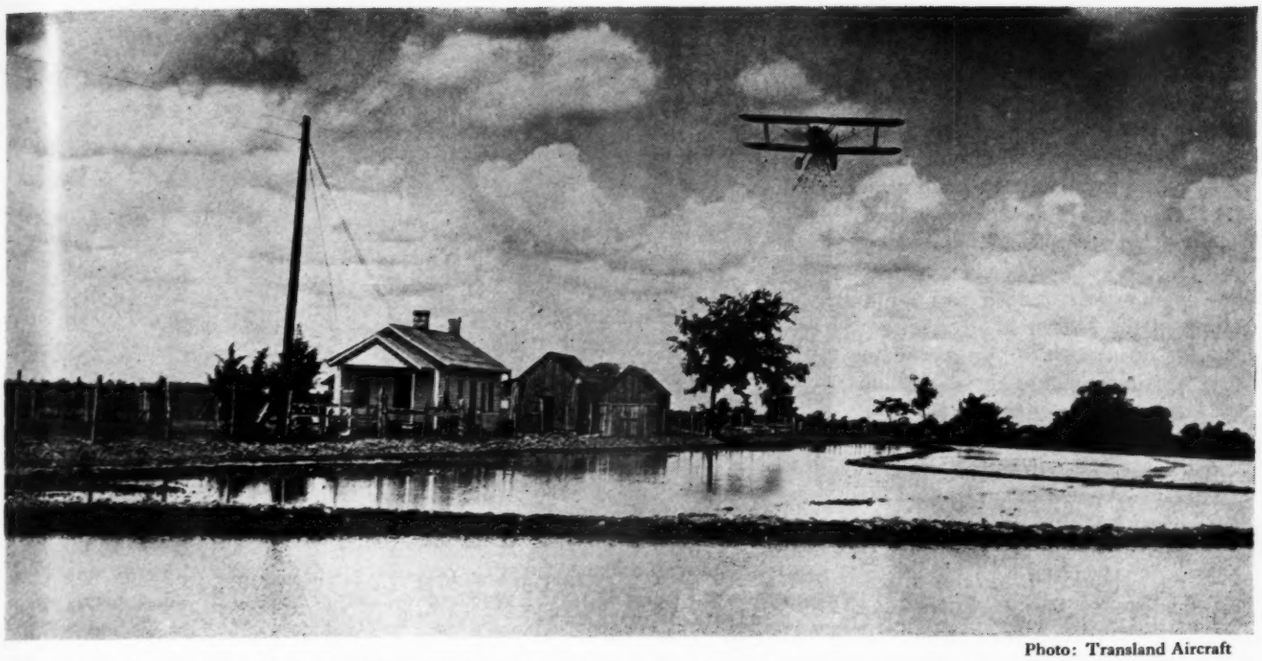


Photo: Transland Aircraft

Planting rice in flooded fields in Louisiana, U.S.A. Aerial seeding adds some 8-10 days to the rice-growing season and gives better distribution compared to ground machines

Machines for Crop Production Under Irrigation—4

Prepared by Officers of the Land and Water Use Branch Agricultural Division, Food and Agriculture Organisation, Rome

THE best method of establishing crops under irrigation varies widely according to the type and variety of the crop, the soil type, method of irrigation, climatic conditions, subsequent tillage and harvesting methods used, and according to economic considerations regarding the investment in equipment that is justified in relation to labour costs, the area being worked and the value of the crop.

The majority of crops may be seeded either by broadcasting, by drilling in closely spaced rows, or by planting in widespaced rows. There are considerable variations within each of these methods and a very wide range of machines is available for each. Only the basic types of machines used for each of these methods, with reference to the crops and conditions to which each type is most applicable, will be discussed.

In the previous parts, machines for land levelling, methods of distributing water, and the functional requirements of machines were considered. Here seeding and planting practices are discussed.

SEEDING AND PLANTING PRACTICES

Broadcasting

This is the standard method of seeding in parts of the world where agriculture has not been mechanised to any appreciable extent. It is, however, also widely used in highly mechanised countries for crops which require seeding on flooded land, in small fields or where obstacles occur which make the use of machines difficult, and for certain seeds which germinate better if not covered.

What is commonly known as the *cyclone-type hand seeder* is probably the simplest manufactured machine for broadcasting. It can be used for practically any crop which is seeded in this manner. It consists of a rotating disk fitted below a seed container, from which the seed feeds to the disk through an opening in the base. The rate of seeding is controlled by varying the size of this opening. The disk is kept revolving by the operator by means of a crank and gear arrangement. The width of seed spread will vary greatly according to the type of seed being sown, and somewhat in relation to the speed at which the disk is driven. It is commonly used for sowing grass seeds, either alone or on land previously seeded to small grains.

Another centrifugal type of broadcaster, often known as the *end-gate seeder*, is used under similar conditions. It is really a powered model of the

cyclone seeder, described above. It is usually mounted on the rear of a tractor and the rotating disk or disks are driven from the p.t.-o. of the tractor. In general, it can only be recommended where conditions practically prohibit the use of a grain drill.

A number of types of *fertiliser distributors* can also be used for broadcast seeding. They consist of a long hopper carried on wheels at each end. The bottom of the hopper is fitted with a metering device driven by the wheels. It is particularly useful in seeding certain types of grass seeds, although it can be used for practically any type of seed. Its main advantage over the centrifugal-type broadcaster is that the distribution of the seed is usually more even and is not affected by wind.

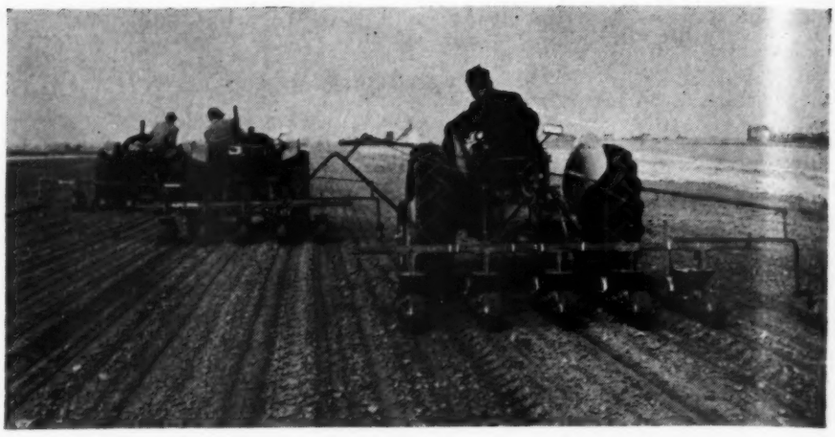
Mention should be made of broadcast seeding by *airplane*. Its most popular application is in the seeding of rice on flooded fields, particularly in the U.S.A. A very large percentage of the rice grown in that country is seeded by aircraft. Other crops have been aerially seeded to a limited extent. To be economical quite large blocks of land are required.

Drill seeding

In this method the seed is sown at an even depth in regularly spaced rows, but at somewhat random spacing in the rows. It is almost universally used for the seeding of all small grains where inter-row cultivation is not practised. Because of the greater uniformity of seed distribution and better control of seeding depth, grain sown in this manner tends to give higher yields than when broadcast.

The machine which is generally used for this type of seeding is commonly known as a *grain drill*. A wide variety of sizes of these drills are available, ranging from those which can be operated by a single animal up to the large tractor-drawn types. They are also available either with a single hopper for seeding grains only, or with a double or divided hopper, in which case fertiliser can also be placed with the seed. Attachments are also available for drilling small grass seeds. With these combination types, grain, grass seed and fertiliser can be sown either independently or in any desired combination.

The feed mechanism is ground-driven. Two types are commonly used. These are known as the fluted force feed and the double-run feed. The fluted type probably gives a more positive feeding action; however, it is somewhat limited in the types of seed that can be sown. The double-run type can seed anything from small grains to larger seeds, such as beans and maize.



A gang of three five-row Stanhay seed-spacing drills planting sugar-beet

Furrow openers are normally spaced at from 6-7 in. They may be of four basic types: the hoe type, the shoe type, the single disk and the double disk. Under irrigated conditions probably the single-disk type is most commonly used. This type is most effective in penetrating heavy soils and in handling considerable surface trash. Through the use of scrapers it also can be kept clean and prevented from clogging in wet, sticky soils.

In crops where depth of seeding is particularly critical, the double disk is preferable, as the disks can be equipped with depth gauge bands, which closely regulate the depth of seed placement.

The newer models of drills can be obtained from most manufacturers equipped with rubber-tyred wheels of the size commonly used on automobiles. This type is preferable for irrigated conditions, particularly where wet, sticky soils are encountered. Some manufacturers also supply tractor-mounted machines. These are most advantageous for work in small fields.

Row-crop seeding

Many crops, due to their habit of growth, to the necessity of providing space for subsequent tillage and harvesting operations, or to allow for the proper distribution of irrigation water, can best be grown in fairly wide-spaced rows. Common row spacings vary from 22-40 in. The placement of seed in the rows may follow any one of a number of practices or methods. The choice between these depends on a combination of factors, such as the type of crop being grown, whether it is best planted on the flat or on ridges, and on the thinning, weeding and harvesting methods subsequently employed.

Random-spaced drilling. With certain crops the percentage germination of the seed may inherently be quite variable and also may vary considerably according to soil physical conditions, temperatures, moisture etc. Certain crops may also be particularly susceptible to disease, to insect damage or to difficulties in emerging due to the formation of a crust over the soil surface after planting.

Under these conditions usually considerably more seed is sown than would be required if a high percentage emergence could be expected. Plants in excess of those required to provide the desired field population are then thinned out in the early stages of growth. Such crops are usually seeded by random scattering of relatively large quantities of seed in the row. This method is used both for seeding on the flat and on ridges.

Precision drilling. Where conditions as noted above do not exist and a high percentage of the seed can be expected to germinate and develop into healthy plants, the cost both of seed and labour can be materially reduced by placing individual seeds at the correct spacing to provide a plant population which will give the highest yields.

This method has become the most popular in recent years for many row crops. This has been due to better

seed selection and grading and to the fact that more accurate and easily operated equipment for this work has become available, but more particularly because of the increased popularity of mechanical harvesting equipment. This method can also be used for sowing both on the flat and on ridges.

Check row planting. This involves the placement of groups of seeds at equal intervals in the row, and the groups so indexed that plants will be in rows across the field as well as in the direction of seeding. This allows for mechanical cultivation across as well as down the rows and thus can assist greatly in reducing the labour required for weeding. The spacing of groups of plants in the row is usually equal to the row spacing, so that the same cultivating equipment can be used in both directions without adjustment. It will be seen that to take advantage of the feature of cross-cultivation it is almost essential that seeding should be done on the flat.

In the past, this has been a very popular method of planting crops such as maize, where a relatively low plant population is required. In recent years, however, it has lost favour, first because the planting equipment required is rather costly, requires more maintenance and is much slower in operation, but mainly due to the increased use of mechanical harvesters and chemical weed control. The control of weeds by selective herbicides almost eliminates the necessity of cross-cultivation. Mechanical harvesters generally operate much more efficiently, when plants are evenly spaced in the row, rather than in bunches.

Hill drop planting. In this method also, groups of seeds are placed at equal intervals in the row, but no attempt is made to index the spacing in relation to the space between rows to allow for cross-cultivation. It has been used primarily where it is found desirable to place a number of seeds together to assist the young plants to emerge in soils which tend to form a crust on the surface after planting. It also considerably facilitates in-the-row weeding operations when this work is done by hand. It has, however, lost favour in recent years for the same reasons as outlined under check row planting. With this method crops may either be sown on the flat or on ridges.

Row-crop seeding equipment

There is some confusion regarding the nomenclature of row-crop seeding machines. Between local districts and wider geographic areas both the terms 'drill' and 'planter' are used to some extent synonymously. In general, where the machine is of the precision type and will actually space individual seeds, it is called a planter. For random in-the-row seeding, where a machine is made up of either one, or a number of single units, each with its own seed hopper, feed mechanism and furrow openers etc., it may also be called a planter, *e.g.* vegetable seed planter. If, however, it consists of a single long seed hopper to which are fitted the seed mechanism, tubes, and furrow openers for a number of rows, it is usually called a drill, *e.g.*, the beet drill.

All row-crop seeding equipment can be grouped under two basic types, namely, precision planters and random drill planters, according to the accuracy with which they are able to space individual seeds or groups of seeds. Both are available as a complete machine, usually in either one-, two- or four-row sizes, to be pulled by animals or a tractor, or as units for mounting on a toolbar on the rear of a tractor or on the main-frame member of front-mounted tractor cultivators.

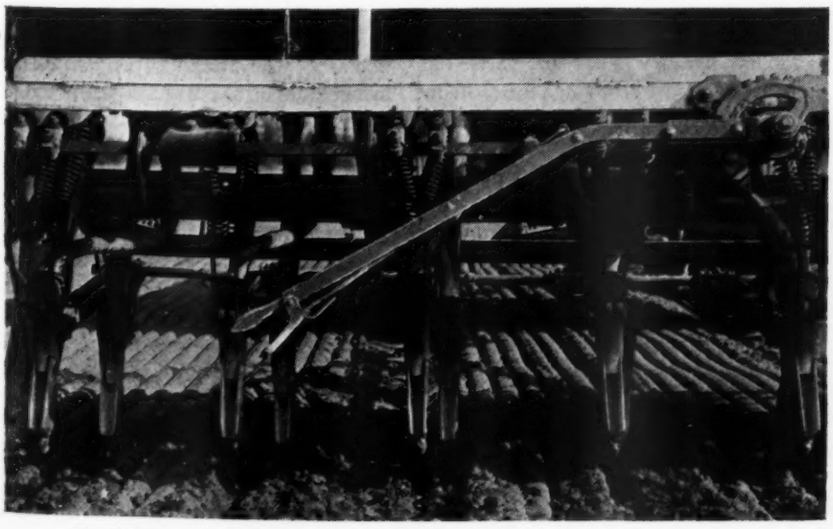
Both mounted and drawn types are adaptable for planting on the flat, but for ridge seeding, the tractor-mounted types are preferred. Row spacings in both types can be regulated by varying the spacing of the individual units on the planter frame or tractor toolbar.

Precision Planters

These are made up of individual units consisting of seed hopper, feed mechanism, delivery tube or boot, furrow opener and, in most cases, a press wheel which follows the furrow opener. The accuracy at which seeds can be spaced by a machine depends mainly on the design of the feed mechanism and to some extent on the boot design.

The most popular type of feed mechanism for precision planters is the horizontal revolving plate design. This consists of a thin plate, around the circumference of which evenly spaced holes of the correct size to hold only one seed of the crop being sown are drilled or moulded. This plate is turned by a ground-driven mechanism (usually from the press wheel) and is fitted into its frame so that, as each cell passes the opening over the seed tube, the seed contained in it is dropped or is forced out.

The spacing of seeds thus depends on the distance between the seed cells in the plate and on the speed at which the plate is driven in relation to ground speed. A wide variety of plates are available with seed cells of varying sizes and spacing, to suit the shape and size of the seed to be sown and the spacing desired. Special plates and seed ejection devices are required for seeds such as undelinted cotton, which is difficult to feed evenly, and for



David Brown 'Albion' seed and fertiliser drill equipped for sowing peas

certain other seeds, such as groundnuts, which damage easily.

Types of precision planters

Precision planters may be divided into three groups, according to the method in which they space or group the seeds in the row:

In *precision drill planters*, in order that the accuracy of seed spacing in the row follows as closely as possible that provided by the feed mechanism, the seed tube or planter boot should be short, straight and smooth. This type of planter therefore always has the seed hopper and feed mechanism located close to the furrow openers, and the cast-iron boot is often equipped with a smooth steel inserted feed tube.

Hill drop planters usually differ from the precision drill type only in the design of the boot. In order to group seeds closely and accurately space these groups, provision is made to allow the number of seeds desired in each hill to accumulate at the base of the planter boot and to ensure their regular and simultaneous ejection.

This is achieved by equipping the boot with a mechanically-operated valve at its base. Seeds accumulate against this valve when it is closed and are ejected by it into the furrow when required, according to the desired spacing of hills. This valve mechanism is mechanically operated, usually from the ground-driven press wheel.

The number of seeds per hill is controlled by the spacing of seed cells in the feed plate and by the speed at which this plate is driven in relation to ground speed. Some hill drop planters have an additional valve located near the top of the boot. This valve remains closed when the bottom one is open, thus preventing the dropping of single scattered seeds in the row.

Check row planters normally use the same feed and boot design as the hill drop type. The seed valves in the boot, however, rather than being mechanically operated from a ground-driven wheel, are actuated by buttons on a wire which is stretched the full length of the field and passes through a tripping device on the frame as the planter proceeds. This wire is moved across the field as planting advances.

Random drill planters

Even where accurate seed spacing is not required the majority of row crops are seeded with *precision-type planters* using a horizontal plate-type feed mechanism. To provide for higher rates of seeding, plates with more closely spaced seed cells are used and/or they are rotated faster in relation to ground speed. Although these planters are somewhat more expensive than some other types, they have the advantage that they are adaptable to a wide variety of crops and provide for better control of seeding rates.

Planters using *stationary opening seed metering devices* are extensively used for planting vegetables and some other row crops. In this type of feed the bottom of the seed hopper is equipped with a plate containing a number of holes of varying sizes. The rate of seeding is regulated by adjusting this plate to provide a hole opening of the correct size for the rate of seeding required. The seedbox is also equipped with an agitator, usually of a revolving type, which operates above and close to the seed plate to prevent bridging of the seed and to assist in its more or less continual flow through the hole.

This is a very inexpensive type of construction and is relatively free from mechanical troubles. With it, however, accurate rates of seeding are difficult to maintain and it is normally only used in specific crops mainly of the vegetable type. Most single-row, hand-driven planters are of this type.

Where random drill planting is only to be done on the flat, for many crops the *common seed drill*, as used for ordinary closely-spaced grain crops, can be utilised. Wide row spacing can be obtained by blocking off some of the feed holes in the seed box. Unless inter-row tillage is desirable at planting time, draft can be reduced and unnecessary wear of parts cut down by also removing the furrow openers and feed tubes, which are not used for seeding. Row spacings that can be used with this type of machine are, of course, limited and also the type of feed mechanism commonly used on these machines restricts their use to certain types of seeds only.

In areas where large acreages of specific crops are commonly random drilled on the flat and at standard row spacings, *special seed drills* have been manufactured basically for the one crop. The beet drill is an example of this type. In most cases these drills differ in basic design from the common grain drill only in the matter of row spacing and overall size and weight of construction.

Furrow openers

Row-crop seeding machines are usually equipped with either runner or double-disk-type furrow openers.

The *runner type* is most widely used. Various sizes and shapes of runners are available for varying soil types and according to the weight and general design of the planter they are used on. A long curved runner is most popular. Short stub-pointed types are used to some extent under rougher soil conditions and where considerable trash may be encountered.

Double-disk openers are used mainly in wet, sticky soils which would tend to build up and clog on the runner type. The disks can be provided with scrapers to keep them clean.

Special attachments

A wide range of attachments are available for both types of openers. *Depth gauge shoes or wheels* are used with crops where depth of planting is critical, and particularly where soil conditions may vary considerably within a field. *Covering shovel attachments* are required in soils which do not fall in well to cover the seed following the furrow openers. Where pre-emergence sprays are used for weed control at planting time the planter furrow openers are usually equipped with *clod sweeps*, which leave a smooth soil surface on each side of the row and thus assist in improving the effectiveness of the spray. Either *blade- or disk-type furrower attachments* may be used where it is found desirable to plant the seed in a shallow furrow.

For planting on ridges or beds a wide *cultivator sweep* is usually mounted ahead of the furrow openers. This sweep cuts off the dry soil at the top of the ridge and throws it aside, leaving a smooth moist soil surface in which the seed is deposited.

Fertiliser attachments are supplied for practically all types and makes of planters. Various designs of fertiliser placement shoes are available which may be adjusted to place the fertiliser in single or double, or even interrupted bands, and either with the seed and/or at varying distances, above or below, or to one side of it. Soil experts should be consulted regarding the method of placement which is most suitable to the soil type, the crop being grown and the method of planting.

New Publications

Pest Infestation

Report of the Pest Infestation Research Board with the Report of the Director of Pest Infestation Research. Pp. 55. Illus. H.M. Stationery Office, London. 1959. Price 5s.

In the main body of this report mention is made of items of work now being concluded and of new investigations. One major experiment started in the year under review is on the changes to be expected when grain is stored for long periods under different conditions of temperature and oxygen concentration.

Arising from the many problems connected with the storage and protection of cereals, studies have been completed of condensation on the metal walls of silo bins and on the possible effects of admixed insecticides on seed germination. Work has continued on the study of insect populations in flour mills. Special attention has been paid to the contaminating effect on flour of insecticidal lacquers containing dieldrin or endrin.

Gas-proof sheets are now widely used for covering goods during fumigation. Such sheets may be exposed to high temperatures and bright sunlight if, for instance, they are used in the tropics. The laboratory is attempting, in collaboration with manufacturers, to draw up specifications for sheets made from different types of material, so that users may order them with some degree of precision and confidence in their performance.

The Board point out that insects and other organisms continue to cause severe losses, especially in producing countries overseas. Whereas the position in the U.K. has vastly improved in the last decade, it must be remembered that British manufacturers obtain the bulk of their raw materials from overseas, often from countries with poorly developed facilities for pest control. As a result, the raw materials may be infested and may not, therefore, be acceptable in countries which enforce stringent regulations concerning the degree of permissible contamination of foodstuffs.

The Pest Infestation Research Laboratories have done much research on these and other problems, some of which will be found in the 33 scientific papers published during the year, which are listed in this report.

D. H. GRIST

Indian Tea Association

Tocklai Experimental Station, Indian Tea Association, Annual Report, 1958.

The Scientific Department of the Indian Tea Association is undoubtedly the leading tea research organisation

TROPICAL AGRICULTURE SERIES

Bananas

N. W. SIMMONDS

'An important work of scholarship, rich in its botanical and scientific content . . . that may well have a more general appeal. It will certainly be read with appreciation by members of the planting community and by research workers, not least because of its directness and lucidity. *No book of equal status and content on the banana has hitherto been published.*'
—C. C. Wardlaw, Professor of Botany, Manchester University.

45s. net.

Rice

D. H. GRIST THIRD EDITION

This edition not only brings the subject matter up to date, but is more comprehensive in scope. Much of the text has been rewritten and three new chapters added, covering 'The Genetics of Paddy', 'Improvement by Selection and Breeding', and an appendix on the dangers of pesticides to fish in paddy fields. Previous editions have proved of value to workers throughout the world; this edition extends its appeal to those engaged in the work of selection and breeding paddy in order to improve quality and yields.

48s. net.

Cocoa

D. H. URQUHART SECOND EDITION

The cocoa bean is a primary product of immense importance in world economy, and since the war there has been a considerable increase in demand for cocoa products. This book provides planters and others with the latest information. The main aspects of the plantation industry are discussed and the findings of research reviewed. There are ample illustrations and photographs.

Probably 48s. net.

LONGMANS, GREEN & CO. LTD., 6 and 7 Clifford Street, London, W.1

at present. The staff in North-East India comprises 30 senior officers and includes engineers, statisticians and a tea taster. Fully equipped and staffed advisory branches are maintained in Cachar, West Bengal, Darjeeling and on the North Bank. In London, the Association has a laboratory where advanced work on tea chemistry is undertaken.

The 1958 report includes some 400 pages of valuable observation and information. In addition, during the year members of the staff contributed no less than 19 papers on various aspects of tea culture to scientific journals in India and Great Britain. The Department issues a quarterly journal, *Two and a Bud*, in which current views and experiments are treated in a popular manner. The *Tea Encyclopaedia*, produced by the Department, is constantly revised and brought into line with present findings, and it is the reference book for tea planters in North-East India on all practical points.

One of the fundamental questions facing the tea industry is the long-term effect of heavy doses of sulphate of ammonia on the soil. This is being carefully followed at Tocklai and is dealt with in the report. Connected with this soil problem is the use of leguminous shade trees, a subject very fully discussed, covering observations and experiments made over the past 30 years.

The plant pathology section has much to record, for the pests and diseases of tea are a major problem. Extensive research and field experiment on the tea flower disease are in hand.

On the engineering side mechanical plucking is under study, a very complex problem indeed. Other subjects dealt with by this branch embrace the general scheme of converting tea manufacture from a bulk to a continuous process. In this connection a withering machine has been designed and installed in the pilot factory at Tocklai and a continuous rolling machine. The 'Rotovane', another distorter of tea leaf invented at Tocklai, is under trial in several factories.

Reference may be made to the work in the London laboratory, where the relationship between the liquoring qualities of tea and the chemical make-up of the products of leaf fermentation has now been clarified. The chemical differences between orthodox and C.T.C. teas have also been demonstrated.

The report is loaded with important facts, but it makes hard reading for the non-scientific planter. Whilst it is fully recognised that statements in such a report should not be taken as final conclusions, and that a scientist is diffident on this account of being too definite, it would nevertheless be of value if a simple summary was included at the end of each discussion or description.

C. R. HARLER

Le Riz

By André Angladette. Pp. 127. Second edition. Presses Universitaires de France, Paris. 1959.

This new edition of André Angladette's book on rice is most welcome. The author has made a careful revision of the first edition to present an up-to-date, simple and concise account of the rice industry, from the origin of the plant to world production, distribution and consumption.

Inevitably, one wishes that certain aspects of the subject had been treated in greater detail. The wonder is, however, not the omission of important material, but the inclusion of such a wealth of information within the compass of such a slim volume. It has only been made possible by careful selection of material and the author's gift of clear and concise expression. If one were asked to select the highlight of this book, one could not do better than draw attention to the excellent chapter in which milling methods are described and illustrated by line drawings.

The first edition of *Le Riz* is well known and widely appreciated. This second edition is worthy of an even wider circulation and one would therefore like to see it in an English translation.

D. H. GRIST

Soil Sterilisation

Ministry of Agriculture, Fisheries and Food, Bulletin No. 22. Fifth edition. 1959. H.M.S.O. Price 4*s*. 4*d*., post free.

Effective sterilisation of the soil in glasshouses will destroy most of the pest and disease organisms that live in the soil and attack the crops.

Many improvements in steam main and distributor equipment have taken place during the last decade and these, combined with advances in glasshouse and boiler design, have made soil sterilisation more effective and at the same time have reduced the costs.

Other subjects discussed in the bulletin are sterilisation by steam or chemicals, its effects and the importance of soil treatment after sterilisation. Suitable layouts for the soil shed are described, accompanied by clear diagrams. In the field of chemical treatment the main feature has been the appearance of new materials for use against specific soil-borne organisms and the renewed hope that these chemicals give for better control of soil infection in glasshouses.

Growers will find this a valuable guide, written in plain language, to successful soil sterilisation.

FAO Publications

Plant Exploration, Collection and Introduction by R. O. Whyte. FAO Agricultural Studies No. 41, Rome, 1958. Price $1 or 5*s*.

Agricultural Credit in Economically Underdeveloped Countries by Dr. Horace Belshaw. FAO Agricultural Studies No. 46, Rome, 1959. Price $3 or 15*s*.

Yearbook of Forest Products Statistics in English, French and Spanish. FAO, Rome, 1959. Price $2 or 10*s*.

Methods of Radiochemical Analysis. Report of a Joint WHO/FAO Expert Committee. FAO Atomic Energy Series No. 1, 1959. Pp. 118. Price $1 or 5*s*.

Supplement to the International Directory of Agricultural Engineering Institutions. October 1959. Price not stated.

Preview — Royal Show

It had been intended to publish in the July issue a preview of the Royal Show to be held at Cambridge, but in view of the large number of new products, details of which will only be released at the time of the Show, it has been decided to hold this over to the August issue, when a comprehensive report of the Show will be included.

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Machinery and Equipment

Granular applications from the air necessitate low flying along every other row at a height of 4-10 ft. with a 'Swathmaster'-equipped aeroplane

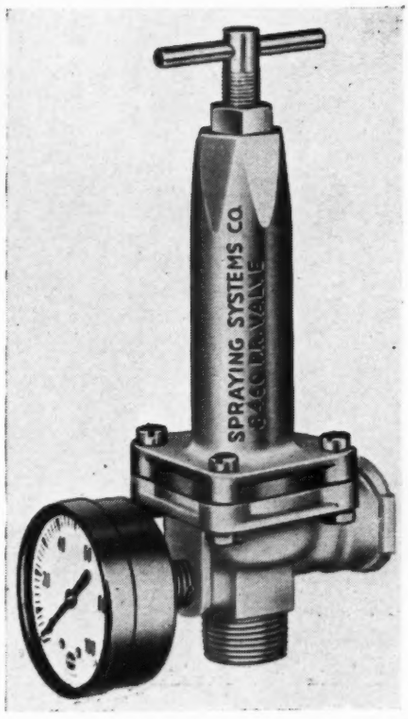
Aerial Spraying

A new pest control technique for eliminating the Argentine ant in citrus groves by applying granular formulations of insecticides on to the ground, thereby avoiding a pesticide residue on the fruit, is being developed at the Citrus Experimental Station of the University of California, the Sunkist growers of California and Arizona, and the Oxnard Pest Control Association of California.

Field tests during the past few years have indicated that ground applicating methods with their unevenness of distribution, however, were not competitive with the more uniform distribution achieved under the trees and throughout the groves by aerial applications. Using *McLoughlin* aircraft, equipped with *Transland* 'Swathmaster' dispensing units, effective control was obtained with half the amount of material needed for ground applications.

Nylon Nozzles

For users who prefer spray nozzles and other parts to be made of nylon, *Spraying Systems Co.*, of U.S.A., offers a large selection in sizes and types of components. Their 'Tee-Jet' nylon nozzles are available with a choice of flat, full-cone and hollow-cone orifice tips in stainless steel, aluminium or brass, and with strainer screens made of stainless steel. For aerial spraying they offer two types of diaphragm 'Tee-Jet' spray nozzles in nylon, both providing a quick and positive shut-off. Recently they introduced the 'DirectoValve' for selective spray control with boom sprayers, and also a new diaphragm pressure relief valve, both accessories being designed so that all parts coming in contact with chemicals are made either of nylon or stainless steel.



The new 8460 diaphragm pressure-relief valve offered by Spraying Systems Co.

The liquid-contact face of the relief valve has a corrosion-resistant diaphragm which gives chatter-free pressure control. Supporting the setting of the diaphragm, there is a stainless steel spring assembly, consisting of a light spring for the lower pressure range and a heavy spring for the high-pressure range. As a result, sensitivity to all pressure settings up to 300 lb./sq. in. is obtained, according to the manufacturers.

Truck Sprayer

A handy 2-wheeled or truck sprayer —'The Rolero'—is offered by the *H. D. Hudson Mfg. Co.*, of U.S.A. The unit consists of a 6-gal. spray tank fitted with a plunger pump, 7 ft. of plastic hose and a lance with a gun-grip or, alternatively a 3-nozzle boom for lawn spraying. This assembly is mounted on a sturdy, tubular frame, carried on two cushion-tyred wheels of 10 in. dia. The truck is steered by the single handle, so that the other hand is free to work the pump plunger or manipulate the spray lance.

Germinating Capacity

The 'Vitascope' and the economy model, the 'Vitameter', are machines for the rapid determination—in a matter of minutes—of the latent germinating capacity of grains and other seeds. The standard methods for this determination by growing some of the seed require between three days to

A handy spraying unit, 'The Rolero'

several weeks; now, with this instrument, a grain or seed buyer can obtain within 10 minutes an indication of the value of a particular lot of seed, so that he can make a quick decision to buy or to reject.

The instrument, which is housed in a plastic cabinet (*vide* WORLD CROPS, 1958, **10,** 308), operates on the basis of a colour reaction using tetrazolium; when enzymes come into contact with the tetrazolium solution it is converted into the brilliantly red formalazine. Thus, if the seed germ is capable of germinating, the split halves will be stained red, otherwise they will remain uncoloured if they are incapable of germinating.

Nils Foss, of *Foss Electric Co.*, of Denmark, is the inventor and manufacturer of these instruments and the *Burrows Equipment Co.* are the exclusive distributors in the U.S.A.

Knapsack Sprayer

A knapsack engine-driven mist-blower has been added to the *Allman* range of sprayers. It is powered by a 2-stroke, 26-c.c. engine running at 4,500 r.p.m., with a 9⅝-in. dia. fan directly mounted on its crankshaft. The spray tank, made of flexible plastic, holds 2.3 gal. and is pressurised by an air by-pass from the fan; the plastic nozzle, which is fitted with an output regulator, is connected to the unit by a flexible rubber hose and is easily handled by the operator.

The assembly is carried on a tubular frame with leather shoulder straps and quick-release arrangements. Thick anti-vibration padding protects the operator and as the unladen weight of the machine is only 26 lb., he is not overburdened.

The new Allman engine-driven knapsack mistblower

The SAME four-wheel-drive tractor making easy work of a very difficult crossing

The 'Mysto' pneumatic sprayer being used to treat individual plants in a herbaceous border

Four-Wheel Drive

Standing in the forefront of Italian agriculture is the *SAME* 4-wheel drive, 42-h.p. tractor, which, it is claimed, overcomes the difficulties of operation in wet rice fields or paddies, since it gives 30% more traction than rear-wheel-drive tractors.

The outstanding feature of this machine is the automatic control unit which ensures that half-carried as well as trailed implements are kept working at a constant depth. The tractor weight is increased by weight transfer from the implement, according to the drawbar pull required. This ensures maximum traction, reduces tyre wear, prevents skidding and results in lower fuel consumption. There is an elastic connection between the implement and the engine, which cushions the shock of sudden jerks occasioned by roots and stones.

The machine has six forward speeds ranging from 0.7-17 m.p.h. and a reverse speed of 3.8 m.p.h. Other interesting features include a hydraulic lifting jack and a meter to check the implement operation. The engine, air filters, pump, carburettors and battery are all easily accessible and the controls are very conveniently arranged around the steering wheel.

Spot Spraying

Where it is desirable to treat individual plants or limited areas so as to use expensive pesticides economically and selectively, the new 'Mysto' sprayer appears to be ideal, for it is not only simple to use, but, weighing only 9 lb., it can be easily transported from place to place. It can be carried over one shoulder, held by one hand,

or it can be rested on the ground while one small area is being sprayed.

The maximum operating pressure is 60 lb./sq. in., at which pressure a safety valve operates. The spray tank is made of steel and is protected internally by a plastic resin coat. Tests over a period of 12 months have proved that both the internal and external finishes are resistant to most chemicals in the laboratory and in actual operating conditions in the tropics. The carrying strap, too, is of rot-proof webbing.

The manufacturers, *W. T. French & Son*, state that it is designed to spray an area calling for 1 gal. of liquid, though other models are available of 2-gal. and 3-gal. capacity. The standard container can be charged with air and liquid in under 90 sec. and it is then ready to deliver spray simply by pressing the trigger on the lance. The adjustable spray nozzle supplied will give either a straight jet or a fine, medium or coarse spray, according to requirements.

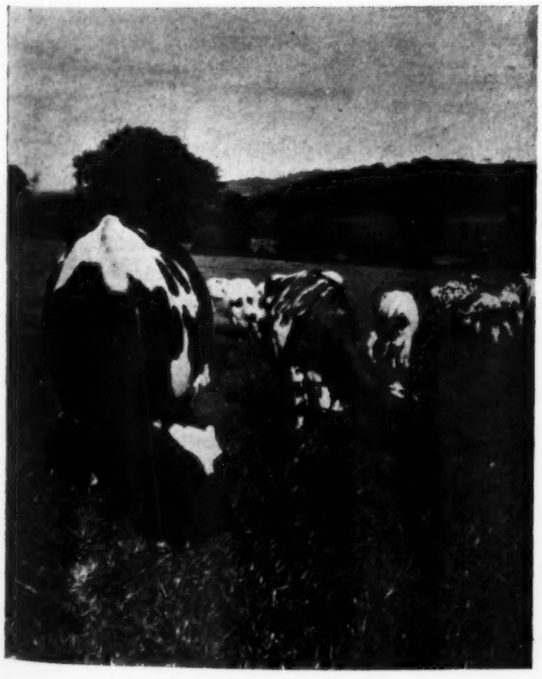
Mechanical Grazing

'Zero' grazing means no grazing at all. The grass is harvested mechanically and brought to the cattle instead of the cattle being taken to the grass. It is claimed for this system that it increases output per acre, because wastage through trampling and 'poaching' is prevented; wastage through soiling with dung and urine does not occur; and the pastures are not selectively grazed.

The system was developed in the U.S.A., where big increases in livestock output per acre have been achieved. Recently a Derbyshire farmer who has adopted the system informed us that last summer he obtained 1,600 gal. of milk per acre and that he fed his 65 Friesians from only 7 acres of grass, equivalent to over nine animals per acre. With a properly co-ordinated system he claims to have obtained 42 tons of green material per acre from this area.

Thus with mechanical grazing it is possible to obtain more grass from each acre. On another farm the rate of stocking was increased by 20% by substituting this system for strip grazing. If the herd is not increased, this means that 20% more land is available for other purposes. Another important point is that the labour requirements of strip grazing are between 50% and 100% greater, depending on the distance of the pastures from the dairy. No water points are needed in the field and no wire or electric fencing, though the system does necessitate a reorganisation in the farmyard to provide for roadside manger feeding.

The basic tools recommended by *Eastern Tractors Ltd.* are a *Massey-Ferguson* forage harvester or a *Gehl* double-chop forage harvester and a *Gehl* self-unloading trailer of 4-5 tons capacity. For complete mechanical feeding the following may be added: a *Gehl* 'Hi-throw' blower, a concrete tower silo, 20 ft. dia. by 40 ft. high, a tower silo unloader and a mechanical auger feeder, which divides the feed among the cattle at the manger.



Left: *Strip grazing with an electric fence.* Right: *Manger feeding with zero grazing*

E1

Agricultural Chemicals and Supplies

Hayrick Coverings

In the past, various types of plastic rick covers, made from 200-gauge material, have been used, but these have not been satisfactory where windy conditions are prevalent. *Opancol Ltd.* are now offering stronger but still flexible sheeting made from 250- and 500-gauge material. The latter is a very economical covering, as it can be used for two seasons, although its first cost is, of course, somewhat higher.

A 250-gauge plastic hayrick cover seen in position

Modern Technique for Gardeners

Dow Agrochemicals Ltd. have brought a proved modern technique of farming to the market gardener by offering their systemic weedkiller, 'Dowpon', in 1-lb. packs. This pack is sufficient to destroy grass weeds on 300-400 yd. of vacant land; there is also a smaller 4-oz. pack designed to treat 80-100 yd. of land.

This chemical, which is non-toxic to man, animals, game and fish, when sprayed on to grass leaves, is absorbed and translocated throughout the plant; it may also be absorbed through the roots. It is for use against such annual grasses as meadow grass, black grass and wild oats, and established perennial grasses, such as black and creeping bent, couch grass, onion couch and aquatic reeds.

The action is slow and the maximum effect on top growth may not be seen for five or six weeks. Recovery of some of the perennial weeds may occur, particularly if the dosage applied was too low; seedling grasses and broad-leaved weeds may also re-invade a treated area. In all such cases the treatment should be repeated, with a broad-leaf weedkiller included.

Ample Boron Supplies

The deposits of borate in the mine at Boron, California, are sufficient to meet any future increase in the demand for boron products, according to a recent communiqué issued by *Borax (Holdings) Ltd.* The borate deposits here are the largest and richest in the world and steps are being taken to increase the productive capacity of the mine by the installation of a 1,300-ft. conveyor system to replace the trucks at present used to haul the ore from the pit bottom to the surface. This will provide a flexible system to meet growing demand.

Pre-emergence Treatment

By destroying weeds before the crop emerges, seedlings can develop freely in an undisturbed seedbed. Having thus eliminated competition for soil nutrients and moisture at a critical period in the life of the plants, the crop is more quickly established, while any subsequent singling of root crops, such as sugar-beet or mangolds, is easier, less costly and more effective.

The greatest benefit is obtained from the use of pre-emergent weedkillers if the spray is applied as late as possible, so long as there is no risk of damage to the germinating crop, for then weed control is more effective. 'Crestol' is a material which can safely be applied late. In fact, according to the *Murphy Chemical Co. Ltd.*, the manufacturers, it can be applied as late as 24 hours before the seedlings are due to emerge, and weed control can thus be effected by a single application. Such close treatment also offers more days, so that the most favourable weather conditions can be chosen.

The treatment will destroy all annual weed seedlings up to an inch in height; the top growth of perennial weeds is also killed, though some re-growth may occur later in the season. The product leaves no harmful residues in the soil, nor does it cause taint – not even in carrots. No protective clothing is necessary when mixing or spraying; it is clean and pleasant to use and will not clog spray nozzles or filters.

This new pre-emergent weedkiller can be used on a wide variety of crops, including sugar-beet, fodder beet, mangolds, turnips, swedes, kale, potatoes, peas, beans, carrots, parsnips, radishes, onions, brassicas and lettuce.

Cold Fermentation Silage

The usual method of making silage in Britain is by the 'warm fermentation process' and heating-up has rather come to be regarded as a basic essential in successful silage making. There is, however, a tendency to include too much air and to allow higher temperatures to develop than are desirable. Actually, according to a recent memorandum received from *Pan Britannica Industries Ltd.*, warmth is only incidental and is not an essential factor; on the contrary, there is an appreciable loss of nutrients and reduced digestibility when overheating occurs.

In the 'cold fermentation process', which is becoming increasingly popular in some European countries, silage is

being successfully made at a low temperature and a more valuable product results, according to *Pan Britannica Industries Ltd.* The silo is rapidly filled with the chopped crop, which is then firmly consolidated to drive out the air, and the silo is immediately sealed to keep out all air. Favourable conditions for the multiplication of lactic acid-producing bacteria are obtained by the use of a chemical additive. For this purpose 'Kylage' is recommended and its action is to inhibit the spoiling butyric bacteria.

Unlike sodium metabisulphite, 'Kylage' is not inactivated by the presence of air, so that it can also be used in the 'warm fermentation process'.

Bracken Control

Trials over the past four years in Scotland and England have resulted in the joint development by *A. H. Marks & Co. Ltd.* and *Amchem Products Inc.* of a new low-volatile hormone weedkiller formulation, 'Weedone Brackontrol', for the control of bracken, *Pteridum aquilinum.* The material is applied by helicopter or suitable ground equipment, *e.g.* tractor, at a dosage rate of 1½ gal. per acre as soon as the fronds have become fully expanded.

The active ingredient in the product is translocated from the frond to the underground rhizome system, where it kills a large percentage of the future frond bud potential. Application under normal conditions will give a reduction in frond population the following year of about 80%, this growth being mostly diminished in vigour. The formulation does not harm useful grasses and sprayed areas with an established sward will provide grazing next year. Where grass is absent, correct after-treatment in successive years with fertilisers, trace elements, seeds etc. will soon restore the land to production. The spray treatment is harmless to birds and animals.

New Weedkiller Plant

Lankro Chemicals Ltd. are to produce the herbicide dalapon (sodium dichlorpropionate) in a new factory in Lancashire. All supplies for the U.K. market are to be handled by *Shell Chemical Co.* and in overseas markets by *Shell International Chemical Co.*

Reader Service

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Dalapon is a herbicide of medium persistence which is used for the control of annual and perennial grass weeds. In the U.K. one of the most troublesome of these is couch grass infesting cereals and other crops. To control this weed dalapon is normally applied in the autumn to land which will be sown with the crop in the following spring.

The Lankro plant will also be capable of producing chlorpropionic acid, which is used for the manufacture of the weedkiller 'Proponex' (CMPP) and other phenoxy-propionic weedkillers.

The Perfect Lawn

According to *Chase Protected Cultivation Ltd.*, artificial fertilisers are necessary, but they should be used with discretion and supplemented by organic methods. They emphasise that it is essential to maintain a healthy and vigorous microflora in the soil by the use of 'Sea-Magic'.

This product, it is stated, will ensure that there is no trace element deficiency, since it contains seven minor elements in readily available form; secondly, it will ensure healthy and vigorous root growth and give greater resistance to pests and diseases because of the presence of auxins and hormones; thirdly, it stimulates the soil bacteria, so increasing the conversion of mineral nutrients into acceptable plant foods; and, lastly, the alginic acid in the product improves the physical condition of the soil and gives improved aeration and water-holding capacity.

It is further claimed that it is better for lawns than urea, for its effects are more lasting and there is no danger of 'burning' the leaves. Urea may appear to improve a lawn which is in poor condition, but the grass will not be as resistant to virus diseases, nor to drought conditions, as when the surface is sprayed with 'Sea-Magic'.

New Group of Herbicides

There is an important announcement in *Nature*, 1960, **186**, 89-90, by H. Koopman and J. Dams, of the N.V. *Philips-Duphar* laboratories in Holland, to the effect that it has been discovered that various benzonitriles and related compounds will inhibit the growth of young oat plants and the germination of the seed of many weed species.

The most active compound in the series was found to be 2,6-dichlorobenzonitrile (code No. H133), which was easily absorbed by seeds either from solution or from the vapour and was also effective in very small amounts. The laboratory experiments showed that the germination of wild oats was prevented if the floats were sprayed with dosages equivalent to 0.5-4 kg. per ha., depending on the type of soil. In addition, it stunted the growth of young plants or killed them, though older and fully-grown plants were not damaged. Growing points were obviously very sensitive to this compound, which acted via the roots as well as through the leaves.

The chemical is active against many weeds, *e.g.* wild oats, *Advena fatua*, bracken, *Pteridium aquilinum*, chickweed, *Stellaria media*, and cleavers, *Galium aparine.* Conversely, some crops have proved resistant and the seeds of some plant species, *e.g.* rice, groundnuts, maize and sunflower, have shown a distinct resistance. These effects indicate the possibilities of using H133 as a selective herbicide.

Plant House Ventilation

The 'Thermofor' is a thermostatic device which will open or close the windows of a plant house according to the conditions. When the temperature within rises too high the vents will open to allow the ingress of cool air; when the air outside is too cold they will close so that the plants are protected from the damaging effects of frost. Thus the commercial grower or the scientist does not have to bother to open and close windows, or to have someone on hand at all times to do this without fail.

The device can be fitted by unskilled labour in a few minutes and once in position needs no further attention once the appropriate range has been set. It is designed to work between 55°F and 80°F and can be set with a 20° limit to suit any crop under glass; thereafter it will operate automatically and reliably.

Forcing Plants

Recent investigations by *Bakelite Ltd.* have demonstrated that tulips can be successfully forced under black polyethylene film during the winter months. The principle is not new, but until recently there was no really satisfactory material. Hessian and bituminised paper are heavy and the paper deteriorates rapidly in the humid conditions of the greenhouse.

The special advantages of black polyethylene film are that it is completely opaque; that where it is overlapped it makes a flat contact with itself so that light cannot get through the join; the material is lightweight and does not crush the plants; it is rot-proof and unaffected by rats, insects, fungi and water; and it can be stored flat for subsequent re-use.

Weeds in Cereals

'Tri-Farmon-41' is a growth-regulating or hormone-type weedkiller based on 2,3,6-trichlorobenzoic acid for the control of a wide range of weeds in cereals, including mayweed, cleavers, chickweed, redshank and, in addition, all weeds normally controlled by MCPA. It is a *Du Pont* product, which is being distributed in the U.K. by *Farm Protection Ltd.*

The manufacturers state that it can be safely applied to crops of winter- and spring-sown wheat, barley, oats and rye if the instructions are correctly followed. The time of application is from the early-tillering (five-leaf) stage until the fully-tillered (jointing) stage, *i.e.* just before the shoot starts to run; they state categorically that the crop must not be sprayed after this period, nor must the recommended rate of application be exceeded either deliberately or else inadvertently by overlapping during the spraying runs. Used according to directions, it is non-poisonous and harmless to humans, livestock and game, but drift on to neighbouring crops susceptible to hormone damage must be avoided.

Forcing tulips under black Bakelite polyethylene. Note how the film rests lightly on the growing bulbs

It acts like other hormone weedkillers by being translocated through the plant and then accelerating and distorting growth. The action is stated to be somewhat slower than with MCPA or 2,4-D, but is just as sure. The characteristic damage appears about 14 days after spraying and during the next 28 days the damage becomes more severe, followed by the collapse and death of the more susceptible weeds and the checking and stunting of others, so that they no longer compete with the cereal crop for light, air, water and plant foods.

One Tin—One Acre

'Weedone LV4' is a concentrated selective weedkiller presented by *E. W. Nickerson & Sons Ltd.*, the seed specialists, in handy 1-acre and 5-acre tins. These handy packs eliminate the handling of bulky drums, make for more accurate estimating and do away with the need for careful measuring. This system can equally prevent damaging over-spraying and the ineffectiveness of under-spraying.

The product is an oil-based emulsion which clings to the leaves and does not easily wash off. It is recommended for the control of many annual and perennial weeds in cereals, grassland and grass seed crops, and it is claimed to be very effective against those most obstinate weeds—knotgrass, redshank and poppy.

Its low volatility obviates loss by vaporisation on warm days, so that susceptible crops, such as sugar-beet, peas and beans, in adjacent fields are not seriously affected if care is taken.

While it is claimed to be non-poisonous to humans, animals and game, it should not be stored near seeds and animal feeds, nor must the material be allowed to contaminate rivers and ponds.

A New Systemic

A new systemic insecticide called 'Dimecron' has just been announced by *May & Baker Ltd.* It is based on phosphamidon, a compound which is rapidly and completely absorbed by green foliage and translocated to the roots and growing point of the plant. Thereafter it functions as a stomach poison to any insects which may devour any of the parts of the plant so treated.

The new product is offered for the control of aphids and mangold fly on sugar-beet and for a wide range of chewing and sucking pests on apple trees. The severe losses caused by virus yellows can be prevented by three-weekly treatments during the dangerous period.

Little and Often

'Compusfood' is a complete soluble plant food which can be used in powder form or made into liquid manure by adding one teaspoonful to 1 gal. of water and applying at prescribed rates. With such soluble mixtures the principle of continuous drip-feeding of very weak solutions can also be applied, or stronger waterings can be given at weekly or fortnightly intervals, so that by spreading the applications the fullest possible intake of nutrients is assured with the minimum losses through leaching, which would otherwise occur with heavier applications at infrequent intervals.

The nutrient requirements of commercial crops growing in various types of soil differ so greatly that it is difficult to prescribe the correct mixture to use, but the manufacturers, *Compusfeed Ltd.*, offer a choice of four mixtures: commercial, high nitrogen, high potash (tomato), high potash (chlorine-free). These concentrates contain nitrogen, phosphoric acid and potash, together with certain trace elements and magnesium; no useless bulking materials or fillers are used.

World Crop Reports

Lower Barley and Oats Production

INTERNATIONAL REPORT

Barley and Oats

The 1959 world crop of barley and oats is estimated at 137 million short-tons. Mainly because of reduced out-turn of oats, production of both grains was 7% below 1958, but was 4% above the 1950-54 average.

Barley production of 3,240 million bushels is only slightly below the large 1958 harvest and is 20% above the 1950-54 average. Smaller harvests in both the U.S.A. and Canada, reducing production to 10% below the large 1958 crops, are more than offset by a record harvest in Europe.

World oats production of 3,685 million bushels is 13% less than the previous heaviest. Though reductions were general, most of the decline was in the U.S.A., where the 1959 crop was 342 million bushels below the revised estimate of 1,416 million bushels for 1958.

The oats harvest in *North America* is down 18%, reflecting the sharp reduction in the U.S.A. because of smaller acreage and lower yields. The area planted was 28.5 million acres, compared with 31.8 million in 1958. Yields were estimated at 37.7 bushels per acre, 15% less than the 1958 average of 44.5 bushels. The barley production of 655 million bushels is 10% less than in 1958, but is 26% above average. Yields were smaller and acreage was down because of a reduction in Canada.

Production of barley in *Western Europe* is estimated at 895 million bushels, 100 million above the previous crop. The largest increase was in France, where an increase of 47 million bushels is due to both increased acreage and higher yields. The good barley out-turn was only partly offset by a reduction of 25 million bushels in oats production, attributable to smaller acreage.

Eastern Europe's harvest of barley and oats was slightly larger than in 1958, despite a moderate reduction in acreage. Barley production is now estimated at 255 million bushels, compared with 240 million in 1958, and is well above average. Oats production of 385 million bushels is also somewhat above the 1950-54 average.

Growing conditions in the *U.S.S.R.* were less favourable than in the excellent 1958 season, and out-turns appear to be well below the large 1958 harvest. A larger reduction is indicated for oats than for barley.

Asia's barley crop is estimated at 815 million bushels, slightly below the previous harvest. The reduction was in yields, for acreage was slightly up. Production of oats is now placed at 95 million bushels, compared with 100 million in 1958. Acreage was slightly larger this year.

Production is smaller in *Africa*. The barley crop is estimated at 130 million bushels, down 10 million. Small reductions in both acreage and yields account for the decline. Oats is of minor importance in Africa and the 1959 crop is estimated at 13 million bushels, compared with 15 million in 1958.

Harvesting has just been completed in most of *South America* and no definite appraisal is yet available. Tentative information points to no change from the 1958 barley total of 75 million bushels. Oats production is also placed at 75 million bushels, on the basis of preliminary information, slightly larger than the previous heaviest.

Production in *Australia* is estimated to be well below the record 1958 harvest, but still much above average. The barley crop is placed at 31 million bushels, compared with 65 million a year earlier. Both acreage and yields were down. Less information is available on oats, but it, too, is believed to be much below the previous large crop.

REGIONAL REPORTS

India

Dryness over most of India, with acute drought in the north-west, is expected to reduce spring grain crops in 1960. *Wheat* and *chickpeas*, which are highly dependent on winter rains, have already been hurt by the drought which has prevailed over much of northern India during February and March.

Though it is too early to make an accurate appraisal of the effects of the drought on spring crops, it is generally feared that yields will be well below the record yields in 1959. The unirrigated wheat areas of the Punjab appear to be the worst affected, but there are also some dry areas in the United Provinces.

India's 1959-60 *groundnut* crop was 4,916,800 short tons from 15,305,000 acres, according to final official estimates. Compared with the revised estimates for 1958-59 of 5,389,440 tons from 14,575,000 acres, production was down 9%, despite the 5% increase in acreage.

The decline in 1959-60 production was mainly due to excessive rains during the growing period in the States of Bombay and Madhya Pradesh.

Australia

Wheat

Latest reports indicate that Australia's recently completed wheat harvest totalled 190 million bushels. This is 12% below the large 1958 crop of 215 million bushels, but is larger than expected and is reported to be of excellent quality.

The acreage of 11.5 million acres was well above average, but yields were below average. An increase of 1.1 million acres over the 1958 wheat area was shared in by all major producing states, but was largest in New South Wales and Western Australia.

Yields were smaller than in 1958 in all states, but the most marked reduction was in South Australia. Yields there are estimated to be only a third of the good 1958 yields, as a result of drought.

Carry-over from the near-record 1958 crop was large, bringing supplies for 1959-60 to a higher level than for the past three seasons.

Rice

Australia's rough rice harvest, which began in April, is tentatively forecast

at 2.6 million cwt. (100 lb.), second only to the record 2.82 million cwt. last year. Acreage in the main rice area was reduced because of relatively low prices on the export market, but this reduction was offset by increases elsewhere. So acreage again approximates the 51,000 acres of 1958-59.

Preliminary forecasts of the 1959-60 acreage planted, by area, are as follows (in acres): New South Wales, 44,500; Northern Territory, 5,500; and Liveringa (Western Australia), 2,000. There were small plantings in a new Coleambally irrigation area south of the main rice fields. This year's out-turn in the new area will not affect total production. However, beginning 1960-61, acreage is expected to increase rapidly, as settlers will probably get the needed water allocation for rice growing. Yields are expected to be high.

The rough rice crop of New South Wales is forecast at 2.5 million cwt. If conditions continue favourable, production at the Northern Territory Ltd. may reach 90,000 cwt., compared with 30,000 last year; and the Liveringa acreage may produce 28,000 cwt., against 12,000 in 1958-59.

Tobacco

Australia's tobacco leaf crop is expected to set a new record this season. The 1959-60 crop is expected to be well above last year's record crop of nearly 7,000 short tons, the best that the Australian tobacco leaf industry has had to date.

In the present season it is estimated that about 21,000 acres were planted to tobacco, compared with about 16,000 acres last year.

Tobacco growing in Australia has made considerable headway in quality as well as quantity in recent years. It is today a valuable part of agriculture in northern and southern Queensland, northern New South Wales, Victoria and south-western Western Australia. This is largely due to the intensive research to control disease and improve quality and production.

Cotton

Harvesting has begun of Australia's cotton crop, which is expected to yield more than 7 million lb. This is almost double the weight of last season's harvest, and the biggest since the second world war.

Commercial cotton growing in Australia is restricted to Queensland, mainly because of climatic conditions.

Dried fruits

Rains and high humidity in the latter part of February caused heavy losses in the 1960 Australian dried vine-fruit pack.

The 1960 *sultana* pack is estimated at about 55,000 short tons. The 1959 pack was 75,300 tons and average (1953-57) production was 65,900 tons. The quality of this year's sultana pack is also expected to be substantially lower than in recent years, with the bulk of production falling in the lower grades.

The 1960 *dried currant* pack is unofficially estimated at roughly 8,000 short tons, in comparison with 12,600 tons in 1959 and an average of 14,400 tons in the 1953-57 period. Production of *Lexia raisins* is also reported to be very small.

Ghana and Nigeria

Ghana and Nigeria, the largest *cocoa* producers in Africa, are both believed to have bumper cocoa crops this year, according to Barclays Bank D.C.O. The reasons given are *capsid control through spraying and new plantings coming into production*. Ghana's output for 1959-60 is estimated at 660 million lb., compared with 575 million lb. for 1958-59. Total African production is estimated at 1,376,100,000 lb., against 1,252,940,000 lb. last year.

Trials by the West African Cocoa Research Institute have shown large crop increases over two years when shade was reduced and fertilisers used, while capsid damage was controlled by insecticides. Second-year yields rose from 958 lb. per acre on shaded plots without fertilisers to 3,091 lb. per acre on fertilised plots without shade trees.

Chile

The *bean* harvest is expected to provide 600,000 bags for export: 400,000 Arroz beans (comparable to U.S. pea beans), 130,000 Cristales (comparable to U.S. Great Northern) and the balance red beans.

The total crop is now estimated at 1.7 million bags, compared with 1.3 million in 1959 and a 1954-58 average of 1.8 million.

The 1960 *lentil* harvest, nearing completion, is estimated at about 400,000 bags. This is 30% above 1959 and 63% above the 1950-54 average.

Chile is one of the world's biggest exporters of lentils, particularly of the larger sizes. Of this year's crop, about 240,000 bags are expected to be large lentils, 110,000 of medium size and 50,000 small.

England and Wales

The weather during March was changeable. After a mild sunny period at the beginning of the month, cold winds spread across the country and brought slight snow showers to all parts except the south by the end of the first week. Mild rainy weather followed, but was dispersed on 16th by cold easterly winds. Rain, heavy in places, spread to western districts on 18th, but gave way to warm sunny weather, which covered the country until 26th. During the last week colder, rainy weather spread from the south, and sleet and snow fell in isolated districts.

Wheat generally looked well, although growth was slow in most areas due to the cold weather. *Barley*, *oats* and *rye* were satisfactory. *Beans* had wintered well and were a healthy crop.

On the whole, conditions were favourable for spring cultivations during most of the month and work was well forward except on some heavy soils. Good progress was made with sowing on medium and light land, where good seedbeds were obtained, but very heavy soils were more difficult to work. Germination had been rather slow due to cold conditions.

Good progress was made with the preparation of the land for *potato* planting. In some areas the planting of early varieties was virtually complete and the planting of second early and main crop varieties was well forward. The preparation of land for sugar-beet was also well forward; drilling had commenced in many areas.

Leys sown last year were variable. Early-sown leys were thin and patchy in many districts and some areas would have to be resown; later sowings were making good progress, although growth had been retarded by the cold conditions. Other leys were in fairly good condition; little growth had been made except in a few areas. *Permanent pastures* had freshened in most areas; growth had been slow.

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